lume 18 Number 3

The Welding Engineer

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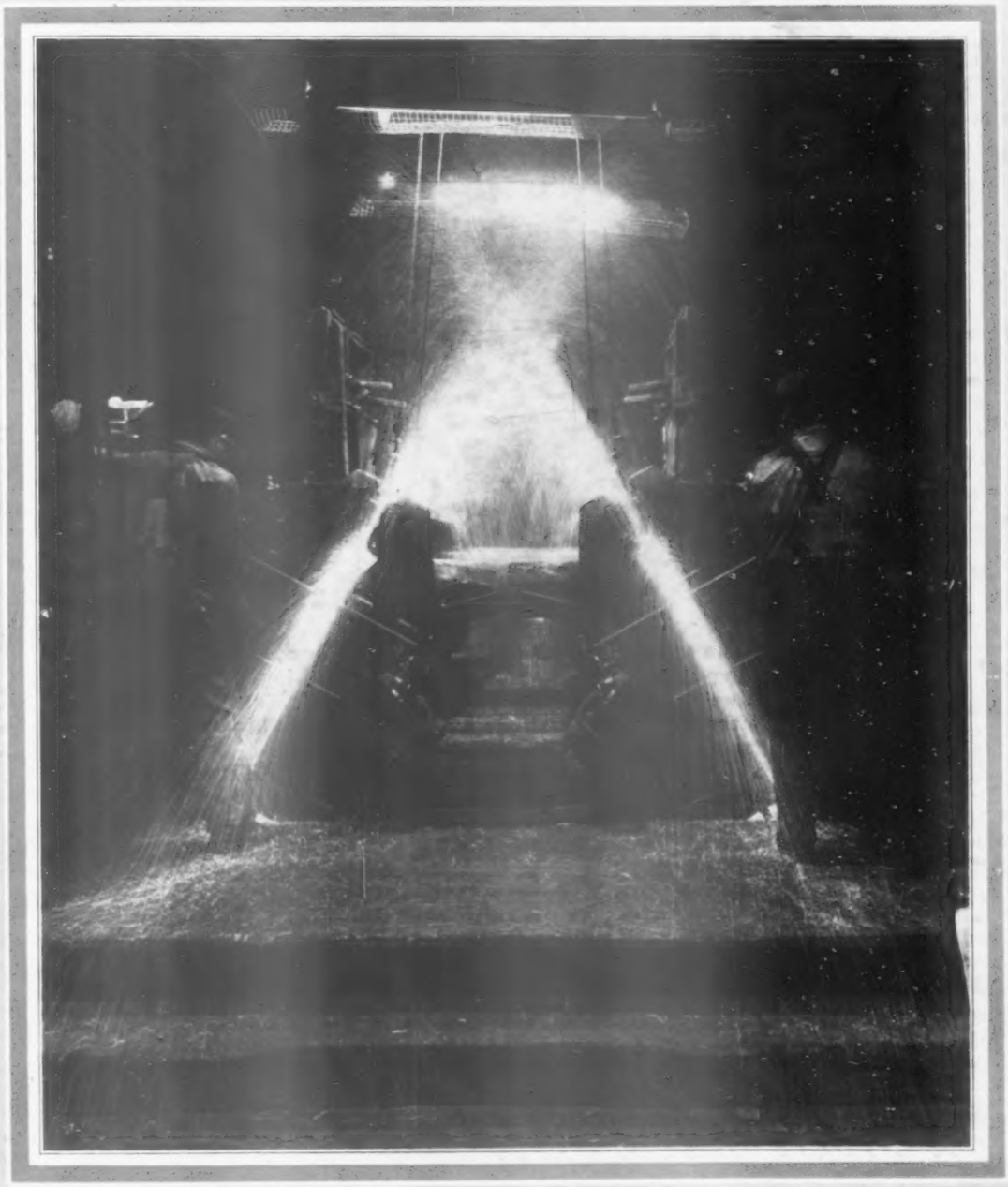
Pioneer Business and Technical Journal of the Welding Industry



h Welding Quarter
s to Rear Center
of Studebaker Cars
(See Page 15)

March · 1933

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THE WELDING ENGINEER

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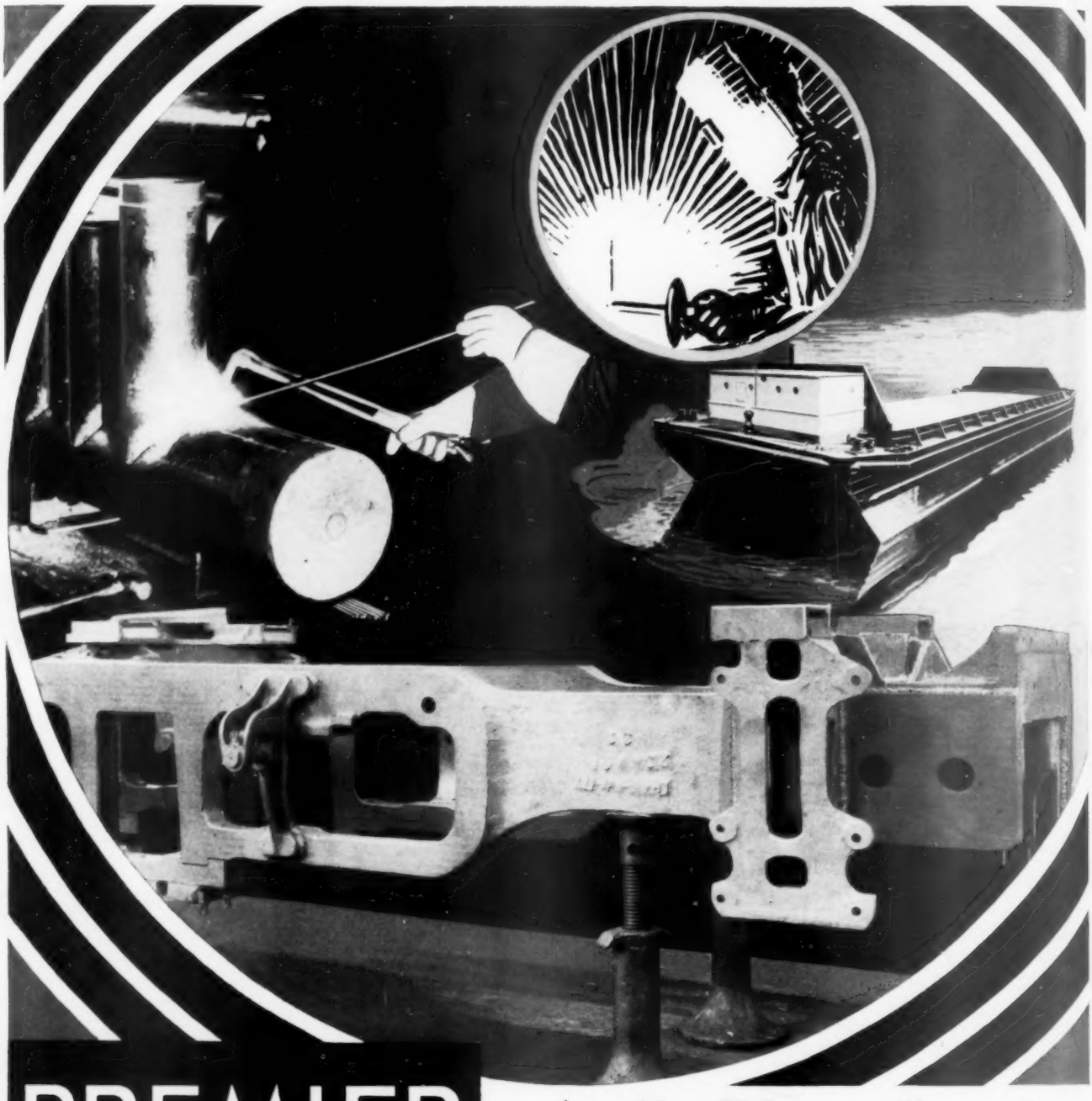

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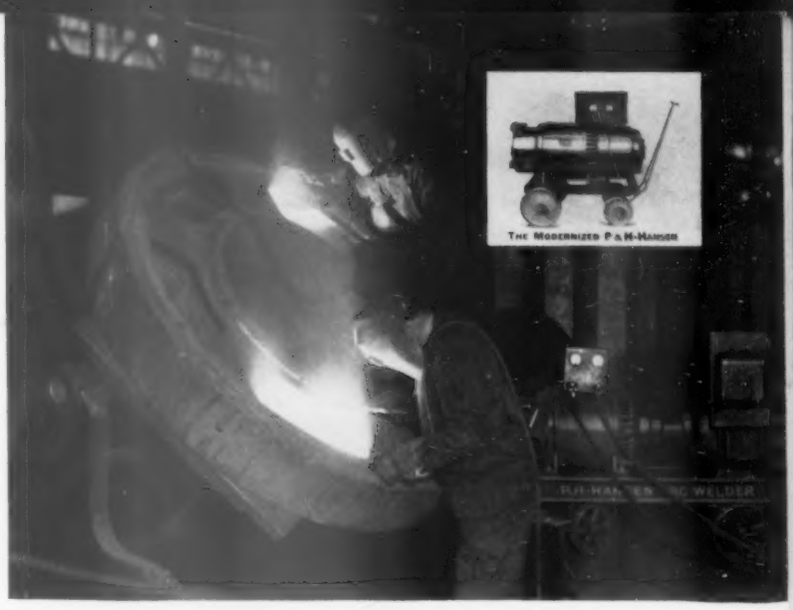

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FOR ANY USE ANY PLACE

Railroad Inspection Car

Has Welded Underframe and Body

By W. M. B. BRADY

CHRISTENED last week in Chicago, this newest type of inspection car, as illustrated in Fig. 1, for division officials of the Chicago, Milwaukee, St. Paul & Pacific Railway, embraces among its many new features construction and assembly entirely by electric arc welding, including chassis, body and roof construction.

THIS car, the first of its type ever built, has many interesting features of design, and represents the latest development in inspection cars.

The plan view of the chassis is shown in Fig. 2. The main frame members were made up of 6-in. ship channels. Sections designated as "A" are one channel with V cut out at bends, forming the outside corners, and welded together in a unit. "B" and "C" are also separate pieces and all welded together, constituting a chassis of one rigid piece. The sections designated as "D" are heavy gussets of $\frac{3}{8}$-in. plate, while "E" are made up of 4x6x$\frac{5}{8}$-in. angles. The pilots (cow catchers) at both ends of the car are made of $2\frac{1}{2}$x$\frac{1}{2}$-in. bars, and are supported by 3x$\frac{3}{8}$-in. angles welded to the underframe. All chassis parts were fabricated with 3/16-in.-diameter General Electric type F welding electrodes, employing 175 amperes. A total of 75 ft. of $\frac{3}{8}$-in. fillet and butt welds, single pass, were laid. Time required was 18 hours, including layout work, assembling, tacking and the complete welding operation.

Sequence of Assembly Operations

The eight cast steel end and corner posts were welded to the underframe, as were also the eight intermediate body and door posts, consisting of 2x3x$\frac{1}{4}$-in. angles. Around the top of these sixteen upright posts are placed the side plates or eave angles, 2x3x$\frac{1}{4}$ in., which follow the contour of the roof; and all sixteen posts were welded to this outline, forming the base for the top canopy. The roof carline 2x2x3/16-in. angles were next assembled in place, forming the roof outline and welded to the eave angles. Plywood was bolted to the roof carlines and all this covered with 22-oz. duck and cemented in place. The side sheets then followed, made of 12-gage cold-rolled patented bevelled plate, which were welded to the underframe around the entire circumference and welded vertically along the entire length of the post, forming the main body wrapper. The backing frames for the windows are $\frac{3}{8}$x$\frac{3}{4}$-in. steel bars welded to the post, eave angles, and top of side sheet, making continuous pockets to form window frames of perfect alignment, snug fit, and vibrationless, as well as going to make up an all-steel body of one piece; and, as pointed out above, the body is welded to the chassis, making the entire coach one-piece construction.

Driven by Own Engine

Fig. 3 covers the interior view of the front end which mounts the major portion of the operating equipment including a 111-hp., 6-cylinder Buda gas engine, dual ignition, with governor control set for 50 miles per hour, though its maximum speed is considerably in excess of this.

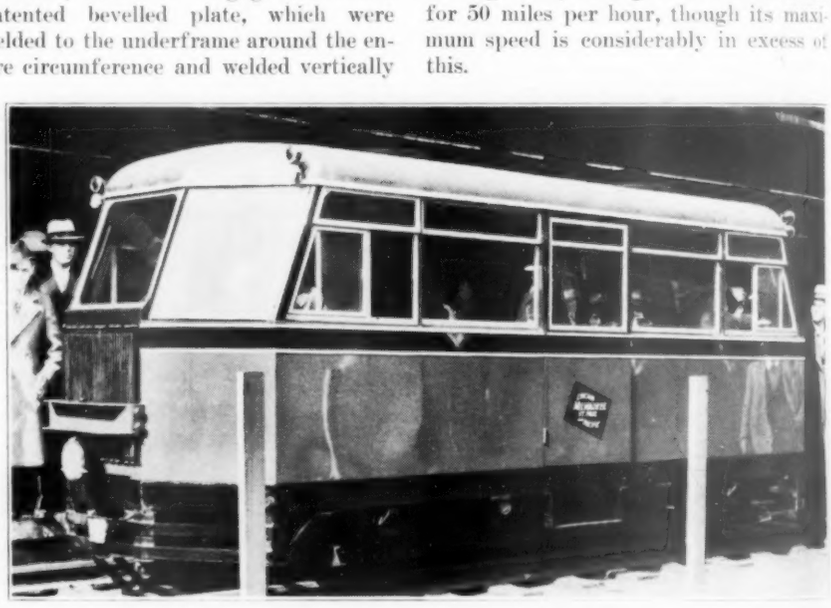


Fig. 1. Self-propelled Inspection Car of Welded Construction.

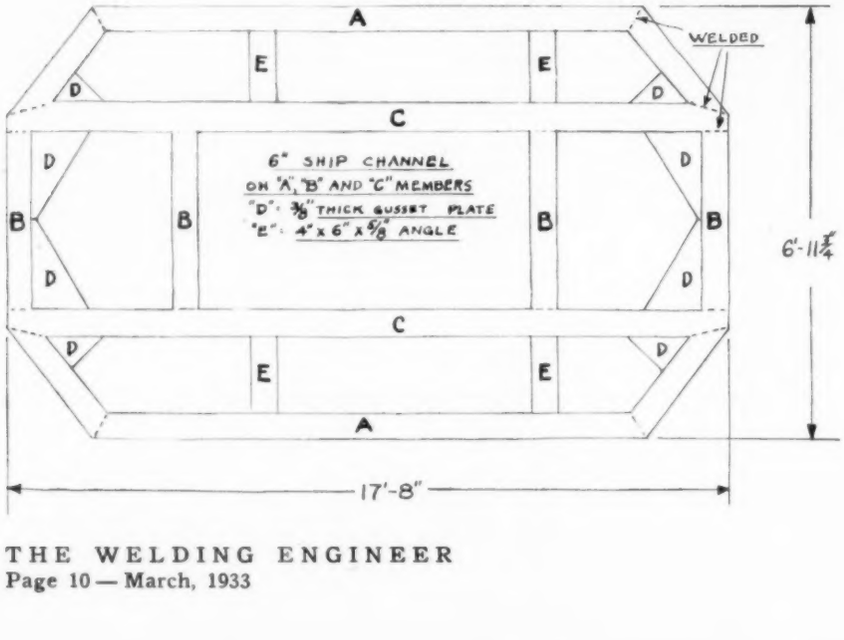


Fig. 2. The Underframe Is Formed of Channels, Plates, and Angles Welded Together.

The car is also equipped with a Young radiator heater fan actuated with double thermostatic control and engine sectional radiator pump circulation for water; 15-gallon water radiator; 50-gallon gasoline tank; 12-volt light and ignition system; Timken bearing journals; vacuum booster braking; Wallis McCormick safety derailing device so the car cannot leave the rails; and Trippe speed headlights.

Four-speed selective-type transmission, with reverse gears built in the rear axle,

Fig. 3. Interior View of Front End, Showing Enclosed Engine and Radiator.

allows the car to be operated at the same speeds in forward or reverse directions with no loss of power in the reverse direction.

Fig. 4 pictures a spacious room with six lounge chairs, not only affording comfort for the inspection officials, but permitting ample room for regrouping chairs to their wishes and conveniences.

The gross weight is 13,900 lb. in operating condition, representing a saving of about 9% in total weight over the riveted type of construction and still retaining all the heavier structural members. Thus

Fig. 4. Rear End of Car with Lounge Chairs.

there is no sacrifice of strength and safety.

All welds were tested and rigidly inspected.

The manufacturers of this coach claim for it an operating cost of 1½c per mile, covering gasoline, oil and maintenance, which is only a fraction of the cost of a locomotive. It will operate seven to eight miles on a gallon of gasoline, so that its 50-gallon gasoline storage tank affords a cruising area of 350 to 400 miles between fuelings.

Where inspection trips are necessary, the car eliminates the old method which involved a locomotive and an inspection coach, necessitating a crew of four to five men. This new coach can be operated by the officials themselves. Then, too, the other divisional officials can go at will any time at their convenience over the division, requiring no layovers, making a saving in valuable time, and affording prompt and close inspection of right-of-way, bridges, signals, tracks, buildings, depots and shops.

The inspection car was designed by Ed. Buker; the body built by the Coach & Car Equipment Co., Chicago, Ill; and the chassis built by the Buda Co., Harvey, Ill., under the supervision of the Mechanical and Engineering Departments of the Milwaukee Railroad.

Symposium on Steel Castings

Ten extensive technical papers have been published under the above heading. These cover carbon-steel and alloy-steel castings. The first two papers give, respectively, a general survey of the industry and statistical data on steel castings production in the United States. Then follows a contribution on the design of steel castings, which emphasizes the importance of cooperation between designer and founder and discusses contraction and crystallization phenomena.

A following paper explains design factors influencing test specimen results, and chemical limitations for carbon steel, and summarizes the A.S.T.M. and other specifications for carbon-steel and alloy-steel castings. One of the most extensive papers gives physical and mechanical properties of some well-known cast steels.

Representative properties of cast medium pearlitic steels are thoroughly reviewed. Involved are pearlitic carbon and low-alloy steels, containing various percentages of molybdenum, vanadium, chromium and nickel, chromium steels for high temperatures, and pearlitic manganese steels.

A technical paper on "Castings of Corrosion-Resistant Steels" gives extensive data on the principal classes of these alloys, covering physical properties at room and elevated temperatures, machining and welding behavior, coefficient of thermal expansion, melting point, maximum temperature for safe use, etc. This contribution also includes a discussion of general considerations affecting alloy selection and it outlines the features of the several alloys. Other papers cover austenitic manganese steel castings, problems and practices in the heat treatment of steel castings. Many test data are given on the welding of cast steel by the arc, oxyacetylene and atomic-hydrogen methods, and the effect of annealing on the physical properties of welds.

This collection of papers is published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., and the American Foundrymen's Association, 222 W. Adams St., Chicago, Ill. The booklet has 254 pages and is priced at $1.00.

New Type of Welded Floor Construction

A welded steel floor in the form of a cellular structure of keystone-shaped steel beads was described by Dr. J. H. Young, vice-president of the H. H. Robertson Co., in a speech before the annual convention of the American Institute of Steel Construction. Each unit of this floor is built by preforming two steel sheets and subsequently welding them together in the plane above the neutral axis. As delivered to the construction job, the unit is either two cells (12 in. wide) or four cells (24 in. wide), and in the longest length convenient for handling and for adaptation to span requirements. The maximum weight per unit, except in special cases, is about 400 lb., although generally the units weigh less than 250 lb. The design is claimed to be such as to develop the maximum efficiency.

Fundamentally, the original keystone-shaped cell possesses a great deal more strength than is needed for many low-span conditions and is adaptable for all general floor construction. Mr. Robertson explained, however, that the strength may be modified by changing the gage of the plates or the method of assembly of component parts.

This type of flooring, in addition to great strength and rigidity, speeds up erection time, since workmen can use the floor immediately after it is laid and before welding to the cross members. The multiple cells of this type of floor are potential electrical ducts or raceways for electrical service, which is a very important feature.

Giant Hangar Has Steel Floors

When the new naval airship hangar, at Sunnydale, Calif., is completed, more than 7 miles of welding will have gone into its construction. The dimensions of this giant structure, which is to house the new navy dirigible MACON, will be approximately 1200 ft. in length by 308 ft. in width by 225 ft. in height.

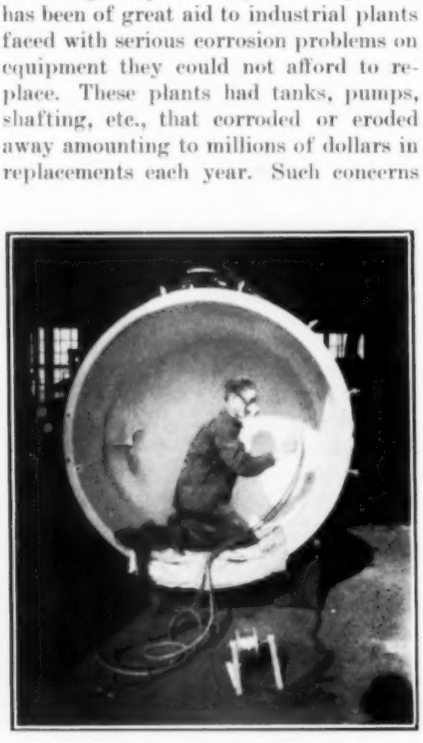
The laying of the plate steel battledeck mezzanine floors, which run the entire length of the building, one on each side, is by far the largest job of structural welding ever performed in California. The floors consist of steel plates 12x2 ft, 3/16 in. thick, welded together. The splices between the ends of the plates are welded buttstrap joints.

Application and Economics of the Process of Metal Spraying . . .

■ By CHAS. STIPP
Metallizing Company of America, Inc.

ALTHOUGH the process of spraying molten metal has only recently become quite generally adopted in industries, development of the idea began fifty years ago in Germany. Like all scientific inventions, the first equipment was inefficient and found few practical applications. The history of the process from that time on is extremely interesting and full of major improvements, and the past few years and even the past few months have been crowded with new uses. The World War stimulated the usefulness of metal-spray equipment by providing many places where the process could save metal, particularly copper.

During the past two years the process has been of great aid to industrial plants faced with serious corrosion problems on equipment they could not afford to replace. These plants had tanks, pumps, shafting, etc., that corroded or eroded away amounting to millions of dollars in replacements each year. Such concerns



Lining Steel Tank With Metal to Resist Acid Corrosion.

welcomed metal spraying and have cooperated whole-heartedly in developing money-saving applications in their own plants.

The unit used in "metallizing" or metal spraying weighs slightly over two pounds, and contains a small air motor that pulls a wire from a spool through the center of an oxy-acetylene flame, where it is melted, then atomized and blown on the piece to be coated.

EXAMPLES of how metal spraying, or "metallizing," has made profits for the user are cited in this paper by Mr. Stipp read before the Welding Conference at Iowa State College, Ames, Iowa, January 18-20, 1933.

Obtaining a Bond With the Base Metal

Any metal that can be drawn to wire form can be sprayed onto practically any surface. The bond does not depend on the composition of the article being sprayed but on the characteristics of the surface. In order to get perfect adhesion it is necessary to sandblast hard, smooth surfaces such as metals and glass before they can be coated. The sand-blasting not only rids the surface of foreign matter but etches it in such a way that every minute particle of sprayed metal secures an individual bond, giving a homogeneous bonded surface.

It is also important in securing a good bond that the particles be very finely atomized in order that their impact velocity will be high. The extremely fine particles must be molten and should travel at the speed of 33,000 ft. per minute. To accomplish complete atomization, a fine wire is fed through rapidly.

Another advantage of applying metal by the spray process is gained by the lightness of the equipment. It is possible to coat objects regardless of their size and portability. About 25% of metal spraying is done in the field. It is also a simple matter to repair jobs that have already been metal sprayed but have been accidentally damaged in spots.

Twenty-five cubic feet of air passes through the gun every minute. This is sufficient to keep the work cool and prevent any warping from overheating. It also makes it possible to deposit metal on such materials as paper, cloth, and wood without scorching the base material. There is no limit to the thickness of metal that can be applied, and it is easy to build up any particular area as much as desired.

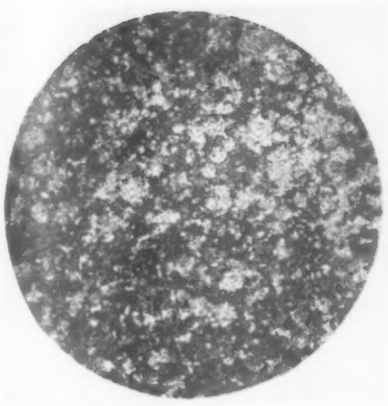
The "metallizer" is started and stopped by one control lever, making it possible to shut the gun off for short periods of a few minutes and thereby reduce operating costs. As soon as the gun is turned on and lit, it is ready to work. This simplicity makes it easy for a man of average intelligence to become a skillful operator with very little practice. No binder is used in the process, as the sprayed metal bonds perfectly to the base, thus eliminating any material that might weather and cause failure.

Replacing Zinc on Welds of Galvanized Material.

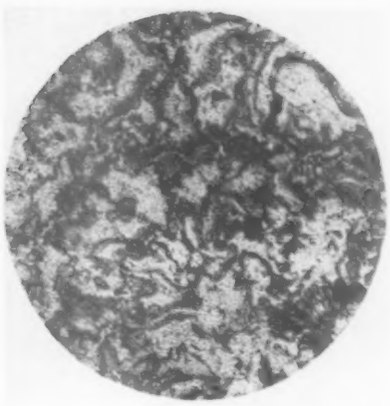
Sprayed Metal Can Be Given Any Finish

It is possible to give sprayed metal any desired finish. It can be machined, ground, buffed, polished, wire brushed, oxidized, or treated in any way a solid metal is treated.

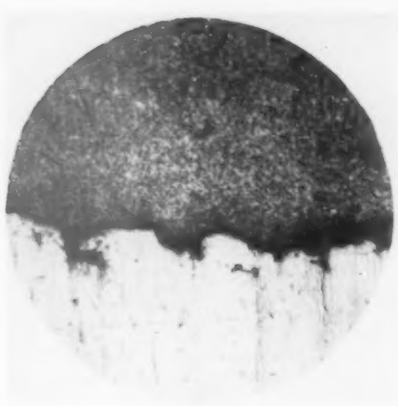
This extreme versatility immediately suggests many applications; but since it would be impossible as well as uninteresting to discuss every application of the process, one use will be discussed in detail



Top view of sprayed zinc showing flattened crystalline structure of the metal particles. Etched with chromic acid. Magnification, 100 diameters. Photograph copyrighted.



Top view of sprayed copper, showing structure of metal. Etched with ammonia hydroxide plus hydrogen peroxide, for 30 seconds. Magnification, 300 diameters. Photograph copyrighted.



Cross-section of a sprayed zinc coating on a mild-steel base, showing even texture of the zinc particles. Etched with chromic acid. Magnification, 300 diameters. Photograph copyrighted.

Photomicrographs of Sprayed Metal Surfaces.

and some others mentioned in a general manner.

Spraying Aluminum in Combustion Chambers

A recent application that became widespread almost immediately is the spraying of aluminum in the combustion chamber of high-compression motors. For years automobile manufacturers have been experimenting with aluminum heads, and when this proved impracticable a few manufacturers went to aluminum blocks and heads to avoid the difference in contraction and expansion of two dissimilar metals. All automotive engineers realize the value of aluminum in the combustion chamber and have been looking for a practicable means of applying the metal. To accomplish this by the spray method, the head is removed and the old gasket held in place with clamps while the head is sandblasted and sprayed with

Automatic Set-Up in Lathe to Coat Felt Rolls in Paper Machines With Copper. This Method Is Also Used to Build Up Shafts.

two coats of aluminum. A new gasket is then installed and the motor assembled.

The aluminum conducts heat rapidly and prevents cold or hot spots, which cause knocks. It also causes, so it is claimed, more of the heat in the gasoline to go to mechanical power and less to heating the motor. Thus the engine runs cooler and develops more power. It appears that in most cases the horsepower is increased 14%. However, the chief reason the application is so widespread is the fact that a motor requiring ethyl gasoline to avoid compression knocks and pings will run smoothly on third-structure gas after it is metal sprayed with aluminum.

A Graham-Paige motor was sprayed and run 200 miles on cheap gasoline with perfect satisfaction, then idled for 48 hours before it was taken down for inspection. This would compare with two months of average driving as far as carbon formation is concerned. Inspection proved that very little carbon was collecting with low-grade fuel.

An 8-cylinder head can be sandblasted in five minutes and sprayed with aluminum in an equal time with a total cost of 80 cents, including material and labor but no profit or overhead. This figure does not include the labor for taking the head off and putting it on. Shops doing this work charge $1.50 to $2.00 per cylinder to the user and $1.00 to $1.50 to garages. This leaves an average profit of $5.00 on 4-cylinder cars and $11.00 on eights.

To look at the application from the point of view of the car user, it is obvious that it pays him to have his motor coated. If we discount the value of additional power, cooler motor, and less carbon formation, the entire application on the average car would be paid for by the time it has consumed 180 gallons of gasoline, and the aluminum coating is good for a much longer period.

Metal Spraying to Prevent Corrosion

Preventing corrosion is the primary application of metal spraying. Chemical corrosion on tanks, pumps, and equipment of any nature is prevented by applying some metal that the particular chemical will not attack. Heat corrosion is combated by aluminum coatings. When the coated object is heated the aluminum penetrates the iron, forming a heat-resistant alloy and a thin tenacious film of aluminum oxide on the surface, which prevents further oxidation. Although the melting point of pure aluminum is 1220° F., this application will withstand heat corrosion up to 2000° F.

Dairies and food-product manufacturers have found the process excellent to

Coating Cast-Iron Annealing Pots With 0.010 In. of Aluminum. These Pots Are Subjected to 1800 Deg. F. in Service.

provide sanitary protection in vats, pasteurizers, cooling coils, filters, and conveyers. Expensive glass-lined tanks have been repaired with tin inlays where the glass lining has chipped out.

Many welding shops have avoided welding galvanized sheets because the protective zinc coating is burnt off. Now some of these shops are spraying the welds with zinc after the structure is completed.

Castings can be salvaged by filling up blow holes and surface defects with the same metal as the casting, whether it be iron, bronze, or aluminum. Worn parts, particularly shafting, can be built up to size, then finished by turning or grinding

and put back into service. The shaft is not overheated. A hard metal such as high-carbon steel is used, having a Brinell hardness of 475.

Applying the Process for Ornamentation

The ornamental field presents a number of money-saving applications for metal spraying. Iron grill work can be given a permanent coating of bronze, brass, nickel silver, or aluminum to give the appearance of a solid, expensive metal casting. Plaster statues can be bronzed, and wood can be economically coated instead of using solid metal.

There are numerous miscellaneous applications such as coating the baby's first shoes for souvenirs, coating telephones as a novelty, making metal caskets out of wooden ones, and coating cast-aluminum cooking utensils with pure aluminum to prevent the copper in the cast aluminum from staining the utensil. Any object can be coated with copper, making it possible to be plated. Automobiles have been given a permanent bronze finish by means of a "metallizer."

Silver Coating Vats and Coils

There are a great many interesting jobs being done at the present time throughout the United States. One of the most expensive and interesting is the coating of several large vats and coils in Kansas City by the Synthetic Products Company. Pure silver was the only metal that would prevent corrosion in this equipment, and up to date 350 troy pounds have been used at a cost of 32 cents an ounce. Applying silver by the metal-spray process was the only practicable method in this case.

Tantalum, a rare metal, is being metal sprayed for Texas Salt Products. Tantalum is the only substance besides glass that will withstand the corrosive action of bromine salts, so it is being used to patch broken spots in expensive glass-lined equipment. The metal costs 40 cents a foot in 18-gage wire. However, the corrosion is so severe it will eat through a 1/4-in. steel tank in half an hour. The glass-lined tanks represent an investment of $3,000, so it is profitable to pay $10 to repair a small spot where the glass lining has chipped off.

In Middletown, Ohio, the Enterprise Machine Company have a "metallizing" unit mounted in the carriage of a lathe and are copper coating felt rolls for paper mills. The gun is lit and the carriage put in gear while the roll revolves, thus making the work practically automatic and insuring an even coating that can be accurately ground. A charge of $20 is made for rolls 6 in. in diameter and 10 ft. long.

Applications of Tinning

The Central Ohio Welding Company in Columbus is engaged in covering 1300 sq. ft. of surface in a milk drier for Borden's creamery. Approximately 260 lbs. of tin will be used, and the job will take about four days. The price quoted in this case was $715.

The War Department has recently specified that a government mineral water tank in Hot Springs, Ark., be metallized with 0.010 in. of tin. The tank is 36 ft. in diameter and 20 ft. high and will take approximately a ton of tin.

In Philadelphia the crankshafts of Sterling motors on coast-guard boats are being built up by Metal Weld Inc., while the Naval Air Base in San Diego, Calif., has equipment of their own to coat the exhaust pipes on government planes.

Platt and Stevens have just completed coating an entire barge with zinc for the Federal Barge Line in New Orleans.

Many other industrial achievements are being credited to metal spraying. Scores of welding shops are now using the process. The industry has unlimited future possibilities.

St. Louis Group Hears Talks on Welding

The St. Louis Welding Society met on February 24th at 316 S. Grand Ave. A. H. Wilson, of the Public Service Company, talked on "The Art of Teaching Welding." Basil N. Osmin, of the Hill Equipment & Engineering Co., spoke on "Stress Distribution in Fillet Welds" and also on "Polarized Light as Used in Modern Machinery Design." Discussions followed. The policy was adopted of sending notices of future meetings only to members in good standing. Notwithstanding the rainy weather, the meeting was well attended.

Chicago Group to Hear Talk on Copper Welding

At the meeting of the Chicago Section, American Welding Society, to be held in the Allerton Hotel, 701 N. Michigan Blvd., Chicago, the evening of March 24th, a paper on "Gas and Arc Welding of Copper and Copper Alloys" will be read by H. G. Wallace, of the Kenosha, Wis., office of The American Brass Co. Mr. Wallace's talk will be followed by a motion picture by the A. M. Byers Co. entitled "The New Story of the Ancient Wrought Iron" and depicting the manufacture of pipe, sheets and plates from wrought iron and the welding of wrought-iron pipe. The showing of the film will be in charge of E. D. Barrett, of the Chicago office of the A. M. Byers Co. The meeting will be preceded by the usual dinner at 6 o'clock.

Seattle Contracts for Arc-Welded Pipeline

A contract for furnishing materials and constructing a pipe line known as the 17th Ave. N. E. pipelines et al from the Maple Leaf reservoir was recently awarded Thos. Sealzo & Co., 50 S. W. and W. Stevens St., Seattle, Wash., by the city of Seattle, according to word received from F. H. Marsh, of Seattle. The pipe will be shop welded and field riveted.

Bids were received for this project based on five alternate types and designs of construction. Bids and payments are on a unit base, from which the following totals were computed:

Riveted steel pipe	$244,877.50
Arc welded steel pipe	217,621.00
Reinforced concrete pipe	225,416.55
Wood-stave pipe	170,051.25
Cast-iron pipe (lead joints)	285,191.00
Cast-iron pipe (substitute joints)	276,715.00
Combination cast-iron pipe and riveted pipe (lead joints)	246,702.98
Combination cast-iron pipe and welded pipe (lead joints)	243,759.98
Combination cast-iron pipe and riveted pipe (substitute joints)	245,979.98
Combination cast-iron pipe and welded pipe (substitute joints)	243,034.98

The main quantities cited in the specifications for comparing bids are: 6600 ft. of 20-in. pipe, 17,800 ft. of 24-in. pipe, 19,900 ft. of 30-in. pipe, and 1100 ft. of 36-in. pipe, all being steel pipe of 1/4-in. wall thickness, together with Dresser couplings for the 20-in. pipe; and cast-steel tees, saddles, bends, manholes with bolts and gaskets, flanges with bolts and copper gaskets, gate valves, etc.; dipping and wrapping, clearing, excavation, backfilling, etc. Each length of pipe will be approximately 30 ft., except where shorter lengths are necessary to produce proper angles or curves in grade or alignment.

Each 30-ft. length of pipe will be made from four pieces 100 in. wide, states George Norris, of the Hydraulic Supply Manufacturing Co., manufacturers of the pipe. Each of these pieces will first pass through a planer for beveling, then through a set of rolls for crimping, then through a second set of rolls for rolling to a true circle. From the rolls, the plates will be sent to automatic welders; the longitudinal seams will be welded by a Westinghouse double-head Weldomatic mounted on a travel carriage, and the circular seams will be welded by hand on the inside and automatically welded on the outside with a Westinghouse single-head Weldomatic. The circular seams will be lapped 2 1/8 in.

High production of automobile bodies requires simplicity in operation in design and proper forming and fitting of parts before welding . . .

Such tests as this one prove the superiority of welded bodies.

Welding in the Studebaker Plant

■ By E. B. RAUSCH

Supervisor of Welding of Body Plant, Studebaker Corporation

Paper read before the Welding Conference at Purdue University, Lafayette, Ind., December 8-9, 1932.

THE general public is turning its time and attention more each year to the manufacture and construction, plus quality, as well as beauty and refinement, in automobiles. The engineering departments in the automobile field have seen this change of public mind and have set out to build a better car. After an enormous amount of experimental work and very severe road tests, it was plainly evident that the screws, rivets, bolts and glued joints were greatly at fault. The screws, as well as nails and bolts, worked loose, and some of the wooden parts split. This meant squeaks and rattles of all kinds.

We began using lighter-gage sheet metals for the outside covering of the bodies, and metal reinforcements took the place of many wooden parts. It was then discovered that the lighter-gage sheets could be formed into pillar posts and, if properly reinforced, would have many times the strength of wood and be much lighter in weight. The same was true of other parts required to make the automobile.

Welding Follows Increase in Use of Metal Parts

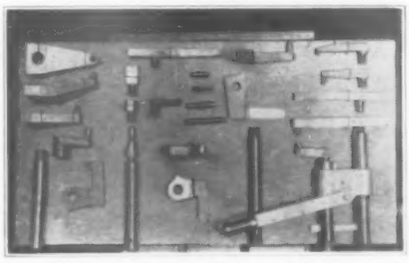
It was at this stage that welding proved to be the best method of assembly. It was demonstrated that any of the methods of welding adopted as standard, such as spot, arc, gas, flash, seam, and projection, would produce satisfactory and reliable welds at low cost. The older methods of assembling sheet-metal products by riveting, bolts, etc., are gradually being replaced by one or more of the modern methods of welding.

Since welding is the basis of our present method of assembly, it is very important that careful consideration be given to the adaptability of the particular type of welding that should be used, and to certain other conditions which have a great influence on this phase of the work. The rate of production must be considered. High production demands simplicity of operation and low cost. The welding operations should not be encumbered by complicated and poorly designed machines.

It is also of great importance that the body design be simple and readily adaptable to the proper method of welding.

Spot Welding Requires Clean Surfaces

The selection of materials to be used is also very important. If spot welding is selected as the proper type for the job, the material must be clean and free from scale and rust if the desired results are to be obtained. Scale, rust or dirt of any kind upon the surface of the metal parts to be spot welded will cause the weld to be burned, and there is very little strength or none at all in a burned weld of this type.



A Few of the Standard Welding Points and Holders Used in the Studebaker Plant.

A very close inspection of the welds made on dirty metal, even though these have a good appearance on the outside, will usually show a crater between the parts welded, in place of a clean, solid fusion of the metal.

Obtaining High Production at Low Costs

It is also of utmost importance to have the parts to be welded together properly formed if a high rate of production is required as well as low cost. For instance, the pillar post panel, which has a contour that must conform with that of the shroud side panel, has the sill and roof rail brackets and hinge reinforcements welded inside the channel section. These parts are sometimes difficult to weld in their proper location, due to the small space in which the welding points have to be used. Hence, it is necessary that the points be very small and at the same time be designed to have sufficient strength to withstand the required pressure to squeeze the parts together and make the weld.

Therefore, it is of great importance that these small reinforcements and brackets fit properly. Otherwise, the pressure required to squeeze the two parts together will be so great that the welding points will break or bend, resulting in a burnt weld.

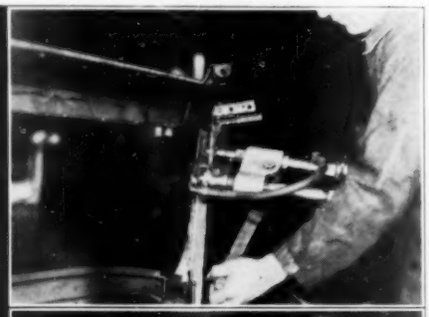
Using the Flash Butt Welder

Flash butt welding, also, has an important place in building automobiles. We have about twelve flash butt welders in operation at present. The arc welder and acetylene torch also have their place, although spot and flash welders are used on most of the operations on automobile assembly work.

WELDING STUDEBAKER BODIES

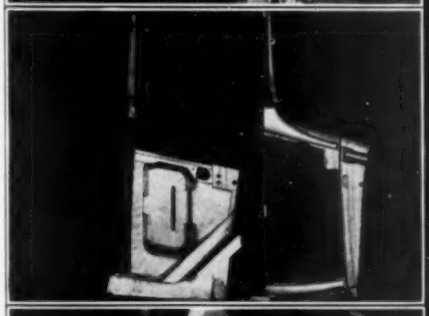
Spot Welding Gusset Assembly to Coupe Pillar

(In the welding of the toe board riser and gusset assembly to the coupe pillar, 3½-in. offset points are used top and bottom. This same setup also welds the riser to the gusset, also the sill bracket to the pillar and gusset.)



Welding Pillar to Door Face

(The pillar to the roof rail bracket is properly located and welded to the door face. By using a flat copper plate between the upper point of the portable spot welder and the door face panel, a flat surface is left on the panel, requiring very little metal finish. The roof rail bracket is also welded to the header bar panel, which requires a long narrow angle-shaped point to reach back in the pocket of the roof rail bracket for welding.)



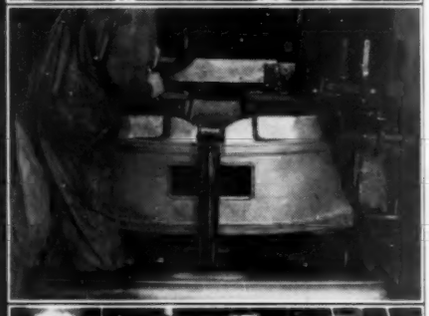
Pillar and Gusset Assembly (Left) and Shroud Side Panel (Right)

(The dark portion in the shroud panel is insulation material, which also acts as a sound deadener. The pillar assembly is spot welded to the shroud side panel in the door rabbit line. The bottom point has a flat contact surface and is cupped out in the center approximately 0.005 in. deep and ⅜ in. in diameter When the weld is made, the pressure on the upper point forces the hot metal into this cup shape in the bottom die. As the hot metal cools it shrinks back in line, leaving a flat surface on the panel which requires very little metal finish.)

Spot Welding Reinforcement Panel to Header Bar

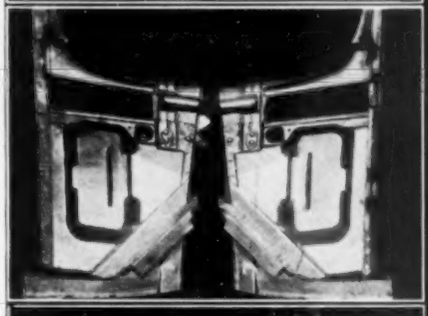
Inside and Outside Views of Shroud Top Panel Assembly

(The small angle sections at each end of the ventilator opening are the shroud top stiffeners.)



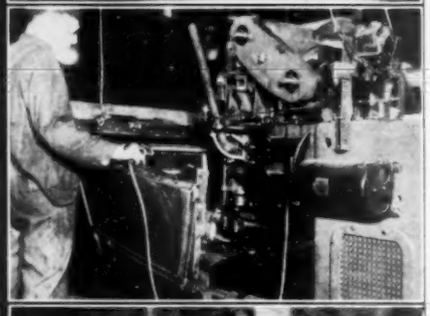
Tack Welding the Dash to the Shroud

(The dash is clamped in place, and the operator is using a portable welder to tack weld the dash to the shroud. This is an indirect weld — that is, one side of the transformer secondary is clamped to the base of the fixture and the current travels through the fixture into the shroud panel, while the other side of the secondary is connected to the belly gun, with which the operator makes the spot weld.)



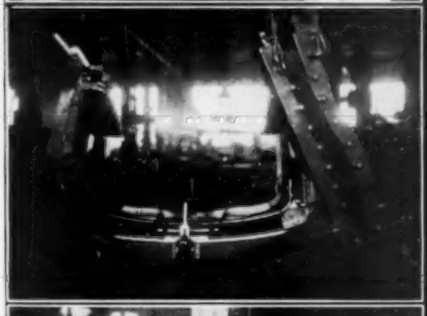
Shroud Side Panels

(The view on the right shows the door hinge reinforcements in the channel section of the pillar. The view on the left shows the pillar reinforcement welded in place. A flat cup-shaped point is also used for spot welding the reinforcement flange to the door face panel.)



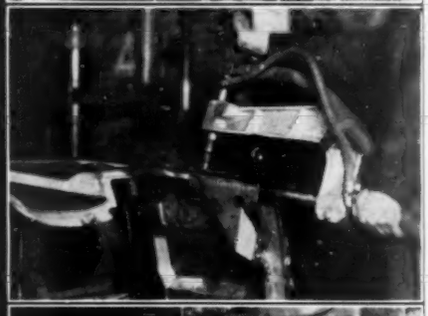
Dash and Shroud Assembly in Spot Welder

(This assembly is put through a power-driven spot welder while suspended from a counterbalanced overhead cable. The operator is clasping a small button-type switch which operates a 110-volt solenoid which in turn trips the clutch on the spot welder.)



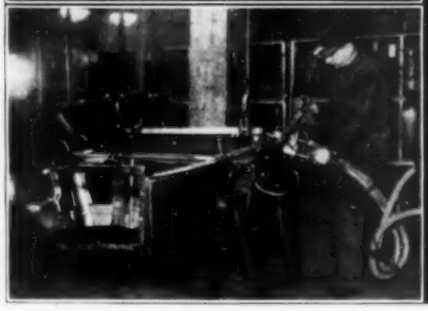
Shroud Sides and Top Panel Clamped in Butt Welder

(Note the heavy cast-iron fixtures used for locating panels in the welder. This assures accurate dimensions. After the shroud is flash welded and taken out of the machine, very little grinding is required to remove the burr on the welds, which is about 1/32 in. in width. This is a very strong type of weld. It is possible to flash weld two pieces of metal together, grind off the burr on both sides, and place in a forming die and form to almost any shape desired, without breaking the weld.)



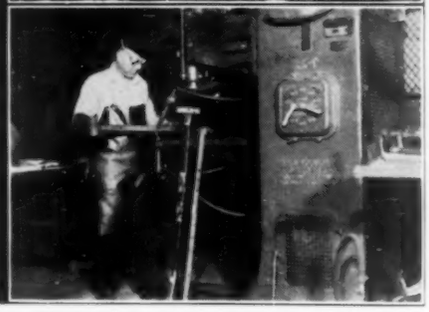
Spot Welding the Dash to the Shroud Panel

(The dash is spot welded to the shroud panel in the toe riser to the dash pocket. The depth of this pocket varies. This particular one is about 12 in. deep. Others are as deep as 16 in. The space in this pocket permits the use of a lower horn on the pinch gun which is only 1¼ in. in diameter. This completes the spot welding on the shroud assembly which is then taken to the arc welder and are tacked in places where it is impossible to spot weld. It is then metal finished and hung on an overhead conveyor which takes it to the final framing fixture.)



Welding Header Bar Panel and Cross Bar to Shroud Assembly

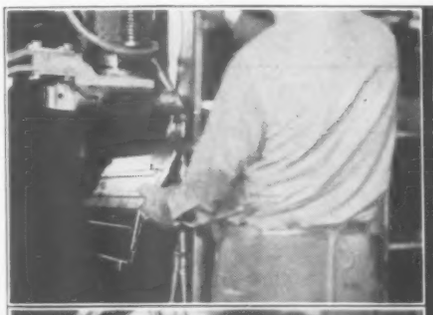
(The shroud assembly is shown in the locating fixture with the header bar panel and the cross bar being welded to the shroud assembly by means of a portable spot welder. A heavy fixture of this type must be used to clamp the parts in their proper location, otherwise the windshield opening would vary in size considerably.)



Spot Welding Reinforcement Flange to Lock Pillar

(This operation requires a flat die cupped out in the center in order to get a flat surface. Two of the pieces to be welded are shown leaning against the welding machine. The channel section at the left is the lock pillar, showing the roof rail bracket, sill bracket, and door lock striker welded in place. The part on the right is the pillar reinforcement which is also channel-shaped.)

STUDEBAKER ROCKNE

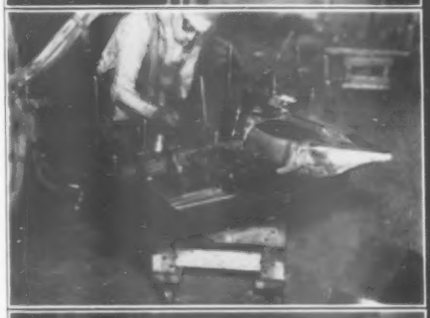


Spot Welding the Seat Pan

(This welder makes 120 spots per minute. Note the setup of the point holders which enables them to get in the corners of the pan. After welding, the seat pan is put on an overhead conveyor and goes to the rear-end assembly fixture.)

Assembly of Upper Quarter Panel to Lower Quarter Panel

(The pillar panel and sill bracket are also located and welded in place. The pillar post assembly is shown lying on the panel.)

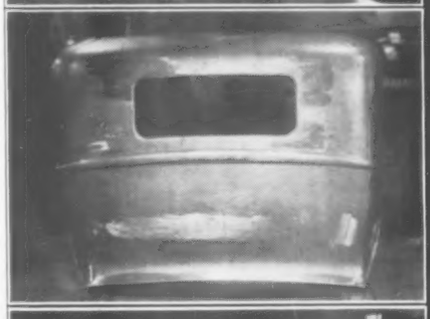


Assembling the Quarter Panel and Brackets

(The operator is welding the pillar panel in the door rabbit line of the quarter panel. The dog leg bracket is also located and tack welded in this fixture. The panel is then taken out of this fixture and finished spot welded on a power-driven machine.)

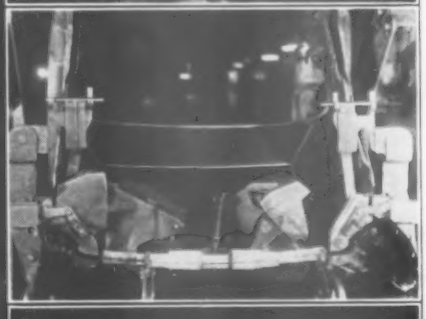
Fixture for Arc Welding Panels

(The lower upper center panel is arc welded to the side panels by means of a special fixture. These panels are of 19-gage metal and are shown clamped down ready to be arc welded. A very hard material known as "malarc" is inserted in a bronze casting and is used for the lower die or backing material. To successfully weld this light-gage sheet metal it is very important to have the panels fit at the joint as closely as possible; otherwise they will burn away when the arc is applied, therefore taking much more time to complete the weld, and the weld will be very rough on the outside.)



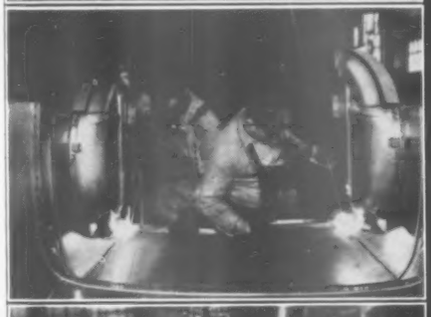
Quarter Panels and Rear Center Panel After Welding

(Heavy, rigid fixtures and clamps are also used to properly locate the quarter panels and rear center panel in the flash butt welder shown on the front cover of this issue. About ⅝ in. of metal on each panel is used for flashing and making the weld. Both sides are welded at the same time, taking about 10 seconds to make the weld.)



Welding the Tail Panel to the Quarter Panels

(This operation requires two standard automatic flash welders mounted on one base and operated from the same control switch. On the left the panels are clamped in position ready to be welded, while on the right the clamps are open. Due to the shape of the panel, it is necessary to use loose sections on the top clamp.)



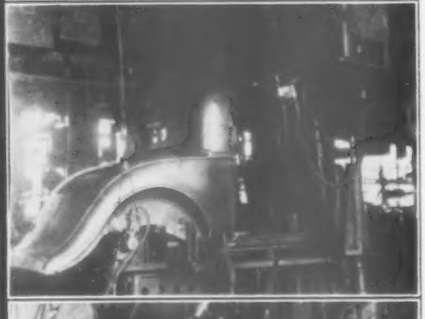
A Gas Welding Operation

(The panel assembly is gas welded over the belt moulding for safety.)

View of Flash Weld in Tail and Quarter Panels

Panel Assembly and Roof Side Panels Ready for Welding

(About the same amount of stock is used to flash off and make the weld in this machine as in the rear center panel welder. All the flash welders used for welding body panels are equipped with air clamps and a mechanical upsetting device which automatically turns the current on and off at the proper time.)

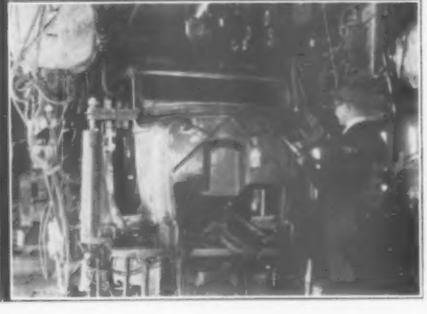


Final Assembly Fixtures

(Here the seat pan is welded in place. There is also a partition panel welded under the fish tail of the body. From a pit under the body, an operator welds the partition panel and reinforcement. The instrument board is also welded to the cross bar to coupe pillar gusset. The transformer and welding guns hanging overhead are used to weld the rear window drain pan and corner reinforcements in place.)

Locating Panel Assembly and Seat Pan for Welding

(One side of the transformer secondary is connected to an electrode mounted on a slide under the seat pan and operated by an air cylinder which forces the seat-pan flange out against the wheel house panel. The other side of the secondary is connected to a push type of gun which spot welds the seat pan to the wheel house panel. Another electrode is located across the back of the fixture, and the seat pan is clamped down on it with air clamps. The bottom flange of the rear center panel is spot welded to the seat pan by means of a pry bar.)



Welding Dash to Shroud Top Panel

(The instrument-board top flange is also indirectly welded to the shroud top panel in the same fixture. The shroud top panel is supported at the line of weld by means of a collapsible support, which is taken out when the spot welding operation is completed. The heavy bar seen lying across the shroud top panel is clamped down by means of air cylinders, and a pry bar is used to do the welding on the instrument-board flange. Five operators weld at the same time from separate transformers.)

Using Tubes as Structural Members—III

Last in a Series of Three Articles

ABSTRACT from a paper by Aubrey F. Burstall, Engineer in Charge of Welding, and Harold Kennedy and Reginald A. Smith, Assistant Engineers, Welding Department, Imperial Chemical Industries, Ltd., Billingham, Stockton-on-Tees, England. This paper was awarded a $100 prize in the Second Lincoln Arc Welding Prize Competition, sponsored by The Lincoln Electric Company, Cleveland, Ohio.

IN ORDER to arrive at the economies in weight and cost to be realized from the adoption of welded tubular construction with spherical joints, the authors submitted designs of a gantry constructed by four different methods, as follows:

Case 1—Riveted angle design.
(Working stress 18,000 lb. per sq. in.)
Case 2—Arc-welded angle design.
(Working stress 18,000 lb. per sq. in.)
Case 3—Arc-welded tubular design with spherical joints.
(Working stress 18,000 lb. per sq. in.)
Case 4—Arc-welded tubular design with spherical joints.
(Working stress 31,400 lb. per sq. in.)

An analysis of the weight and cost of each type of construction was presented. A gantry of the design referred to above as Case 2 was actually erected at the works with which the authors are connected before the tube-and-sphere method of design had been developed.

General Design of Structure

This structure is essentially a bridge consisting of four separate gantries, each 31 ft. 6 in. long, designed to carry a lead pipe contained in a mild-steel sheath. The entire structure is supported at one end by an existing trestle and at the other end by a building. Three sets of intermediate beams and columns support the structure, one end of each beam resting on a supporting column and the other on the wall of a building parallel to the structure, on which side the structure is shielded from the wind. The span of the beams is 7 ft. 6 in. For design purposes, the weight of the pipe was taken as 336 lb. per running foot, or a total weight of nearly 20 long tons. Fully dimensioned drawings showing the general arrangement, elevation, and sections of the Case 4 gantry are given in Figures 17 and 18. [The original paper also gives drawings for the Case 1 and 2 gantries.]

In design work, one may compute the direct stresses and employ a large factor of safety, or calculate the loads much more accurately and design with a smaller factor of safety. The former course was pursued in Cases 1, 2 and 3, because ordinary structural practice follows this course, and a standard stress of 18,000 lb. per sq. in. was adopted, corresponding to a factor of safety of 3.5.

In Case 4, the calculation was carried out much more completely, and a factor of safety of 2 on the ultimate strength, or 1.15 on the yield strength, was adopted, the working stress being taken as 31,400 lb. per sq. in. In these computations, no calculation of secondary stresses was carried out; had this been done, and the terminal fixing couples considered, the total stresses would have been reduced. It would seem, therefore, that Case 4 has a real factor of safety greater than 1.15 on the yield strength and is amply strong for the loads imposed upon it, but it cannot be subjected to additional loads and must be well painted to avoid corrosion.

Safety Factor Reduced by Eccentricities of Loading

The adoption of a direct stress of 31,400 lb. per sq. in. for the Case 4 structure compares favorably with a computed maximum stress of 35,800 lb. per sq. in. [method of calculation is given in detail in the original paper] for a $2\frac{1}{4}$x$2\frac{1}{4}$x$\frac{1}{4}$-in. riveted angle carrying a maximum load, assuming a working stress of 18,000 lb. per sq. in., and based on the Chicago, Milwaukee & St. Paul Railroad Specification for eccentrically loaded members. Therefore, it is concluded, the factor of safety of 3.5 generally adopted for riveted practice is a fictitious figure when eccentricities of loadings are taken into account in light structures involving angles, and that direct stresses of 18,000 lb. per sq. in. over the net area may result in local stresses approximately as great as the yield stress. Therefore, it is claimed, the riveted structure must be kept well painted, just as in the Case 4 structure, to prevent corrosion.

Case 3 was designed and put forward to illustrate that the new method of construction achieves savings in weight and

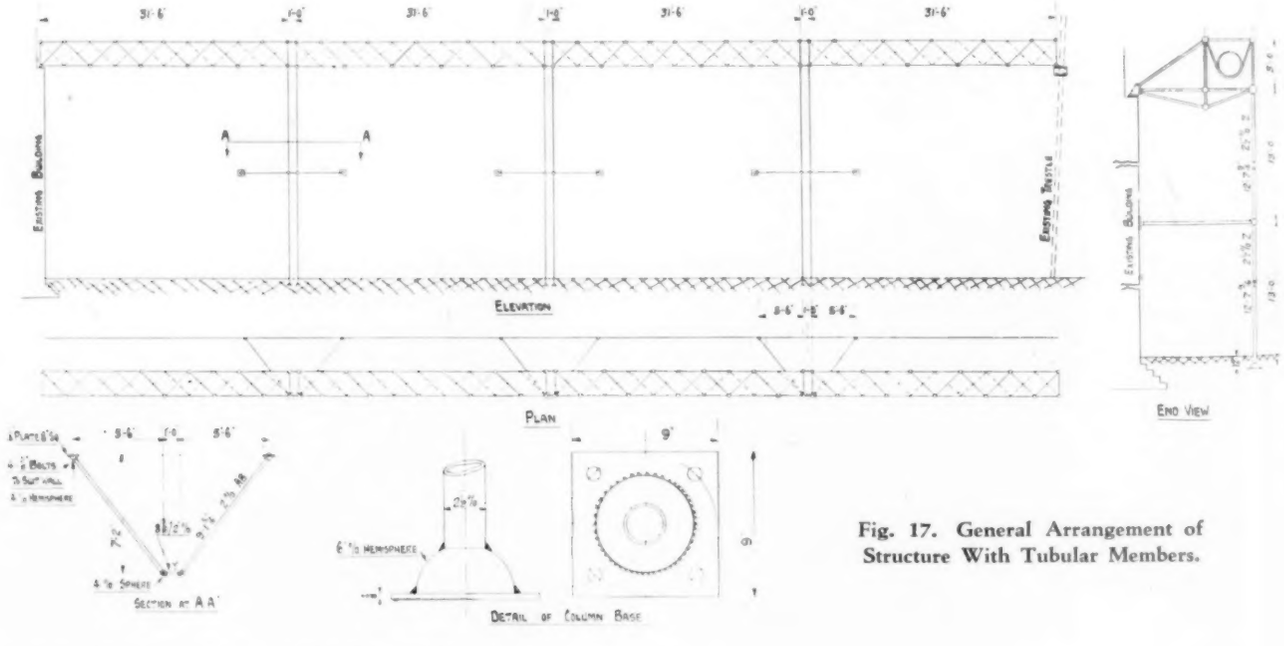


Fig. 17. General Arrangement of Structure With Tubular Members.

TABLE 1. Summary of Comparative Data for Different Constructions of 126-Ft. Steel Gantry and Supporting Columns Designed to Carry a Load of 336 Lb. per Running Foot (Plus Wind and Dead Weight)

	Max. Permissible Working Stress, Lb. per Sq. In.	Total Weight of Structure, Lb.	Saving in W'g't Over Riveted Design	Painted Surface Area, Sq. Ft.	Cost				Saving in Cost Over Riveted Design
					Material	Labor	Overhead	Total	
(Case 1) Conventional Riveted Design	18,000	8007	.....	1286	$156.30	$148.60	$148.60	$453.40	.....
(Case 2) Conventional Welded Design, Using Angles, Etc.	18,000	7360	8.1%	1246	152.20	135.00	135.00	422.10	6.9%
(Case 3) Tube-and-Sphere Construction	18,000	4296	46.3%	630	192.30	87.70	87.70	367.70	18.9%
(Case 4) Tube-and-Sphere Construction	31,400	3247	59.4%	615	141.60	84.60	84.60	310.70	31.4%

cost even if the conservative design stress of 18,000 lb. per sq. in. is adopted. The wind load has been neglected in all cases. Many of the imperfections present in Cases 1 and 2 do not exist in Case 3, where excellent concentricity of load is achieved, so that the factor of safety of 3.5 is much more nearly a real safety factor in Cases 1 and 2 than in Cases 3 and 4.

The cost per running foot of material is taken as the basis for computing labor costs. This has been found in practice to remain almost constant for light structures and to increase when the average weight of the material rises above 18 lb. per running foot. Costs in the United States and some other countries may be different from those used, but the comparisons will still be approximately correct. Where labor costs are higher, there will be a greater saving by adopting tubular construction. The figures given for Cases 3 and 4 in Tables 1, 2 and 3 are the authors' estimates of the labor costs of the new form of construction, based upon a careful analysis of all the operations involved and the experience gained in making specimen spherical joints and other types of welded tubular construction.

The authors have found that the unit labor cost for angle welded construction is virtually equal to the labor cost for ordinary angle riveted construction (see Table 2). This is because increases in supervision, in welding, and in assembly just balance reductions in templating, machining, sawing, riveting, and painting.

Large Savings in Weight With Tubular Design

The last item in Table 3 gives the weight savings for the total bridge 126 ft. long, together with supporting columns and beams. Perhaps the most remarkable achievement is the 46.3 per cent saving in weight effected in Case 3, which the authors maintain is substantially stronger than either Case 1 or 2 owing to absence of eccentricity.

If the weights for the three individual sections of the completed job are compared, it will be seen that by far the greatest saving is achieved in the case of the beam where the total weight is only 76 lb. in Case 3 and 48 lb. in Case 4, as compared with 311 lb. for the riveted design and 245 lb. for the welded angle design. A large saving is also effected in the case of the columns, the reduction in weight being from 704 in both Cases 1 and 2 to 326 and 248 lb. in Cases 3 and 4 respectively. The saving in weight in the gantry itself is slightly less, because here there are an appreciable number of tension members where the saving is less than in compression members, and also there were fewer gussets and cleats for jointing in the riveted design owing to the long span. Even here, however, the saving in weight is 8 per cent in the case of the welded angle design, 33.5 per cent in Case 3 of the tubes and spheres, and 49 per cent in Case 4. There is some difficulty in apportioning fairly the saving in weight between the girder, column, and beam in Cases 3 and 4 on account of the fact that some of the spherical jointing pieces are common to all three.

The following unit costs of material were taken as the basis of material costs in Tables 1 and 3, since they are con-

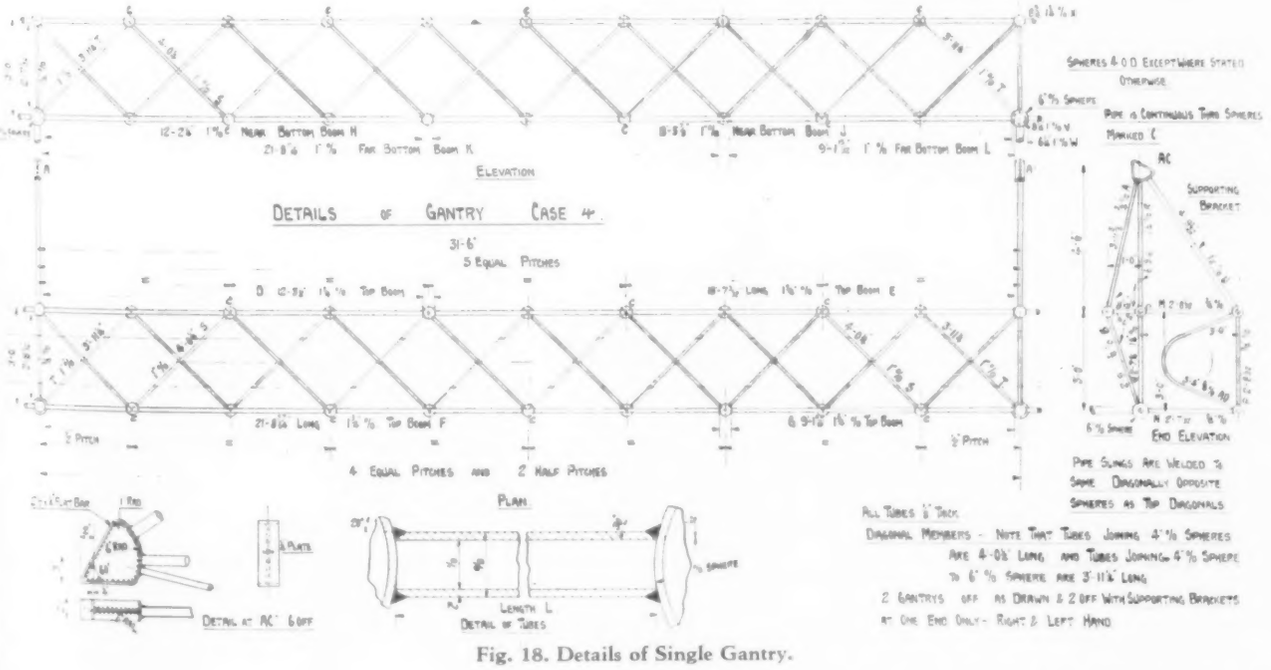

ELEVATION
DETAILS OF GANTRY CASE 4
31'-6"
5 EQUAL PITCHES
4 EQUAL PITCHES AND 2 HALF PITCHES
PLAN
END ELEVATION
SUPPORTING BRACKET
SPHERES 4-0 O.D. EXCEPT WHERE STATED OTHERWISE
PIPE IS CONTINUOUS THRU SPHERES MARKED C
PIPE SLINGS ARE WELDED TO SPHERE DIAGONALLY OPPOSITE SPHERES AS TOP DIAGONALS
ALL TUBES 6" THICK
DIAGONAL MEMBERS - NOTE THAT TUBES JOINING 4'-0" SPHERES ARE 4'-0" LONG AND TUBES JOINING 4'-0" SPHERE TO 6'-0" SPHERE ARE 3'-11" LONG
2 GANTRYS OFF AS DRAWN & 2 OFF WITH SUPPORTING BRACKETS AT ONE END ONLY - RIGHT & LEFT HAND

Fig. 18. Details of Single Gantry.

sidered by the authors as representing present-day costs in their own country (England).

Structural sections and plates .....2c per lb.
Tubes .....4c per lb.
Spheres .....8c per lb.
Welding wire .....6c per lb.

The cost of the welding wire is such a small proportion of the total material cost that it hardly affects the total cost comparison.

It was considered by the authors that the fairest and simplest method of dealing with all the overhead charges (including profit) for structural work, was to take a figure of 100 per cent of the labor to cover all these charges. These include power and shop services, a share of the general works charges and administration charges, repairs and depreciation of machinery, and profit.

Structures to Which Tubes Are Applicable

Obviously one of the most important applications of this type of construction is to the fabrication of buildings and bridges. At the time of writing this paper, the authors had just completed the design of a roof truss for a single-story building, the span of the truss being 77 ft., the fall of the roof 2-in-1, and the height of the building to the eaves 12 ft. 6 in. In this instance a saving in weight of 50 per cent was effected by the tube-and-sphere type of construction as compared with the computed weight of a welded angle roof truss designed for the same loads and with the same factor of safety. The weight of the roof truss in each case was 1570 lb. for the welded angle construction and only 784 lb. for the welded tube-and-sphere construction. Similar savings could also be effected in the case of bridges and other land structures, and the saving is even more striking where the loads are definitely known. The authors also suggest this new construction for the steel-frame arc-welded dwelling, which an attempt has been made to popularize in recent years.

The proposed tube-and-sphere construction can also be applied to the design and construction of masts and pylons and other fixed land structures, to many of which both welding and the use of tubes have already been applied.

The authors of this paper have also considered the application of this construction to the making of chassis frames for automobiles and trucks, mine tubs, hand trucks, and cranes. Other applications of welded tubular construction are to be found in railroad freight cars, mobile fire escapes and ladders.

For a long time the advantages of tubes as structural members have been realized by aircraft designers, who have employed tubes of steel and other materials to form the framework of the

TABLE 2. Comparative Labor Costs for Steel Gantry and Columns

	Assembly	Templating	Machining	Cold Sawing	Welding	Painting	Total Labor
Case 1 (Angle, Riveted)	1.00*	1.00*	1.00*	1.00*	.....	1.00*	1.00*
Case 2 (Angle, Welded)	1.72	.72	.43	.77	1.00*	.91	1.00
Case 3 (Tubular, 18,000 lb. per sq. in.)	1.8	.23	.33	.11	.82	.22	.62
Case 4 (Tubular, 31,400 lb. per sq. in.)	1.8	.23	.33	.11	.67	.18	.60

*Unit taken as standard to which all other cost figures are compared.

TABLE 3. Comparative Cost Analysis for Cases 1, 2, 3 and 4

	Case 1	Case 2	Case 3		Case 4	
			Tubes	Spheres	Tubes	Spheres
SINGLE GANTRY						
Material:						
Weight, lb.	1163.0	1056.5	660.8	101.6	515.8	65.9
Cost, per lb.	2.0c	2.0c	4.0c	8.0c	4.0c	8.0c
Total cost	$22.30	$21.20	$26.40	$8.10	$20.60	$4.80
Gross cost	$22.30	$21.20	$34.50		$24.50	
Weld Metal:						
Weight, lb.	.....	10.0	10.0		8.0	
Cost at 6c per lb.	.....	60c	60c		48c	
Labor:						
Length, ft.	383.50	361.50	368.00		368.00	
Cost per ft.	7.40c	7.40c	4.62c		4.46c	
Total cost	$28.30	$26.70	$17.00		$16.40	
Overhead*	$28.30	$26.70	$17.00		$16.40	
FOUR GANTRIES						
Total weight, lb.	4652.0	4266.0	3089.6		2358.8	
Total cost	$315.60	$300.80	$276.40		$234.70	
COLUMN (Cases 1 and 2, single column including beam connections. Cases 3 and 4, double column including beam connections and stiffeners.)						
Material:						
Weight, lb.	704.0	704.0	312.7	12.6	237.9	10.0
Cost per lb.	2.0c	2.0c	4.0c	8.0c	4.0c	8.0c
Total cost	$14.08	$14.08	$12.50	$1.00	$9.52	$0.80
Gross cost	$14.08	$14.08	$13.50		$10.32	
Weld Metal:						
Weight, lb.	.....	0.5	0.5		0.5	
Cost at 6c per lb.	.....	3c	3c		3c	
Labor:						
Length, ft.	46.57	46.57	84.00		84.00	
Cost per ft.	9.6c	9.6c	6.0c		5.8c	
Total cost	$4.47	$4.47	$5.04		$4.88	
Overhead*	$4.47	$4.47	$5.04		$4.88	
THREE COLUMNS						
Total weight, lb.	2112.0	2113.5	977.4		745.2	
Total cost	$69.06	$69.15	$70.83		$60.33	
DOUBLE BEAM (Cases 1 and 2, beam with angles and stiffeners. Cases 3 and 4, beam only.)						
Material:						
Weight, lb.	414.30	326.30	58.4	17.58	37.2	9.85
Cost per lb.	2.0c	2.0c	4.0c	8.0c	4.0c	8.0c
Total cost	$8.28	$7.53	$2.34	$1.41	$1.49	$0.79
Gross cost	$8.28	$7.53	$3.75		$2.28	
Weld Metal:						
Weight, lb.	.....	0.5	0.5		0.5	
Cost at 6c per lb.	.....	3c	3c		3c	
Labor:						
Length, ft.	76.32	51.32	32.60		32.60	
Cost per ft.	9.60c	9.60c	4.62c		4.47c	
Total cost	$7.32	$4.92	$1.51		$1.46	
Overhead*	$7.32	$4.92	$1.51		$1.46	
THREE DOUBLE BEAMS						
Total weight, lb.	1242.90	980.40	229.44		142.65	
Total cost	$68.70	$52.20	$20.40		$15.70	
Total wt. of structure, lb.	8006.9	7359.9	4296.5		3246.7	
Total cost of structure	$453.40	$422.15	$367.70		$310.70	
Savings in cost over riveted design	.....	6.9%	18.9%		31.4%	
Savings in weight over riveted design	.....	8.1%	46.3%		59.4%	

*For want of a better plan for determining overhead charges, these were taken as being equal to total labor costs.

fuselage, wings and undercarriage of airplanes. For these, welding has been essential at the joints, and up to the present the cost of specially preparing the tube ends has been a serious drawback to the cost of the all-metal airplane. Similarly, in airship construction, although tubes have been used in some cases, special sections have frequently been made, partly to overcome the foregoing objections to the use of tubes. With the tube-and-sphere construction, these objections no longer hold.

At present tubes are being used as structural members by some manufacturers of small motor-driven crafts on account of their great lightness, and the use of spheres will again prove of advantage in making the joints. Difficulties which may be encountered at the points where the structure meets the shell of the boat can be overcome by making spherical segments or deformed spheres, such as the authors have used for mounting the purlins on the roof truss of a building. Similarly, for some types of watercraft, the saving in weight is an enormous advantage.

Meeting of Australian Welding Institute

The annual general meeting of the Australian Welding Institute will be held in the Main Lecture Room of the Working Men's College, Melbourne, on March 28th at 8 p. m. Reports of the Executive Committee and of the auditor will be received, and election of the Executive Committee and of the president and vice-president will follow. At the meeting of the Institute held on February 28th, E. L. Hambridge gave a talk on "The Possibilities of Welded City Buildings."

Indiana Ironsmiths Meet on April 4th and 5th

The State convention of the Indiana Ironsmiths and Welders Association will be held at Purdue University, Lafayette, Ind., April 4th and 5th, this being a correction of the dates given in the January issue of *The Welding Engineer*. Exhibits and demonstrations will be held, including ornamental iron work, tools, electric and acetylene welding, plow sharpening, and pointing and hard-surfacing of plows and tools. Prizes will be offered, consisting of fluxes, a complete welding outfit, and other articles and tools. Though the complete program of the convention has not yet been announced, one of the talks will be by Lee Everson, of the Smith Welding Corp., of Milwaukee. Several manufacturers will exhibit welding equipment. Further information can be obtained from the state secretary, Wm. J. Volpert, Peru, Ind.

Steel Treaters View Films on Welding

At the March 15th meeting of the Indianapolis Chapter, American Society for Steel Treating, motion pictures were shown by The Linde Air Products Co., illustrating the principles of oxyacetylene cutting and welding torches and showing the oxyacetylene welding process in production. Questions following the showing of the films were answered by Fred Outealt, of the Chicago Office of the Linde company. Particular interest was shown in methods of testing, welding-rod quality, and specifications for welding rods. About 60 were in attendance.

Meeting of Institution of Welding Engineers

"Where Oxy-Acetylene and Electric Welding Join Forces" was the subject of an illustrated lecture by O. Simonis before The Institution of Welding Engineers in London on February 15th. Future addresses at these London meetings include "A General Survey of Metallic Arc Welding With Particulars of Some Welded Products," by D. G. Sinfield on March 15th, and a paper on "Improvements in Welding Practice" to be given on April 19th. A meeting of the Institution was held in Birmingham on February 17th, at which J. D. Jevons and M. A. Wheeler presented a paper on "The Metallographic Examination of Welds." At the Birmingham meeting to be held March 24th, H. W. Hawkins will read a paper on "Design and Manufacture of Welded Steel Fabrications." The Midlands branch of the Institution, which holds its meetings in Manchester, has arranged the following program for the remainder of the season: February 22nd, "Applications of Welding to Structural Work," by J. H. Paterson; March 22nd, "Relationship and Applications of Various Welding Methods," by P. L. Roberts; and April 19th, annual general meeting, with film on "Oxyacetylene Welding."

Philadelphia Hears Talks on Bridge Welding

The March meeting of the Philadelphia Section, American Welding Society, on March 20th, will cover "Welding Highway Bridges." Harry K. Ellis, county engineer, Chester County, Pa., will relate "Experiences of a County Engineer in Repairing and Strengthening Highway Bridges," and Joseph G. Shryock, chief engineer, Belmont Iron Works, will present "Modernizing Existing Metallic Bridges by Re-Decking and Arc Welding."

"Mechanical Cutting and Flame Machining," a paper presented by R. F. Helmkamp, Applied Engineering Department, Air Reduction Sales Co., and "Bronze Welding by the Oxy-Acetylene Process," a presentation by F. C. Clark, Technical Publicity Department, Linde Air Products Co., constituted the program of the meeting on February 20th. Due to the excellence of the papers presented, this meeting was one of the most successful of recent gatherings.

Texas Oil Show to Be Held in April

The Oil Equipment and Engineering Exposition will be held in Dallas, Texas, April 17th to 23rd, 1933, some of the exhibits being housed in the Machinery Building at the Texas state fair grounds with 72 acres reserved for outside exhibits. Complimentary admission tickets may be secured by writing the Exposition offices, P. O. Box 301, Dallas, Texas.

Los Angeles Section Holds Lively Meeting

The Los Angeles Section of the American Welding Society held its first general meeting of the new fiscal year with the newly elected officers in charge, on February 16th, at the Mona Lisa Cafe, 3343 Wilshire Blvd. B. M. Laulhere, newly elected chairman, presided at the meeting, which was well attended by a representative group.

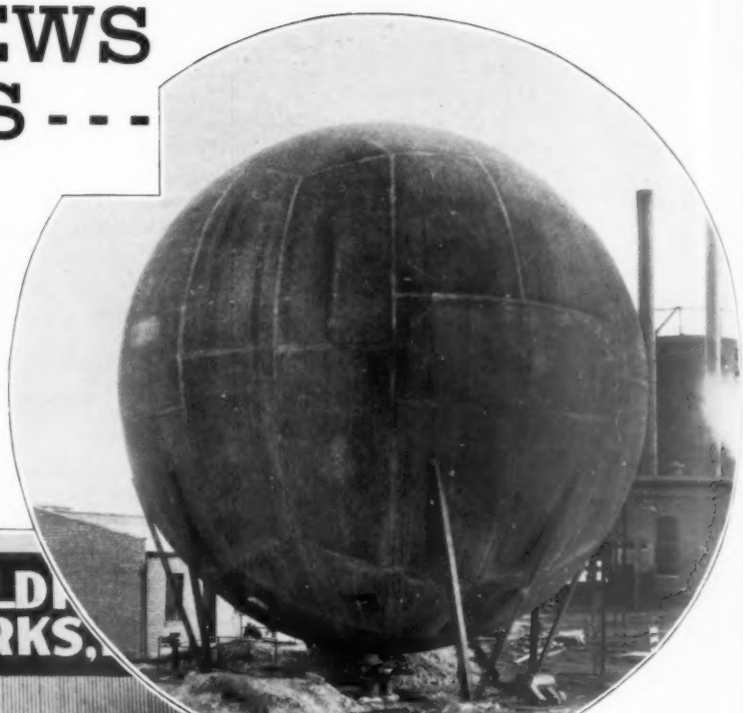
Special features were the presentation of two interesting papers, the first being by Wayne Howard, testing engineer for the Consolidated Steel Corp., of Los Angeles. The subject of Mr. Howard's paper was "Some Factors Governing the Choice of Welding Electrodes." A lively and interesting discussion followed.

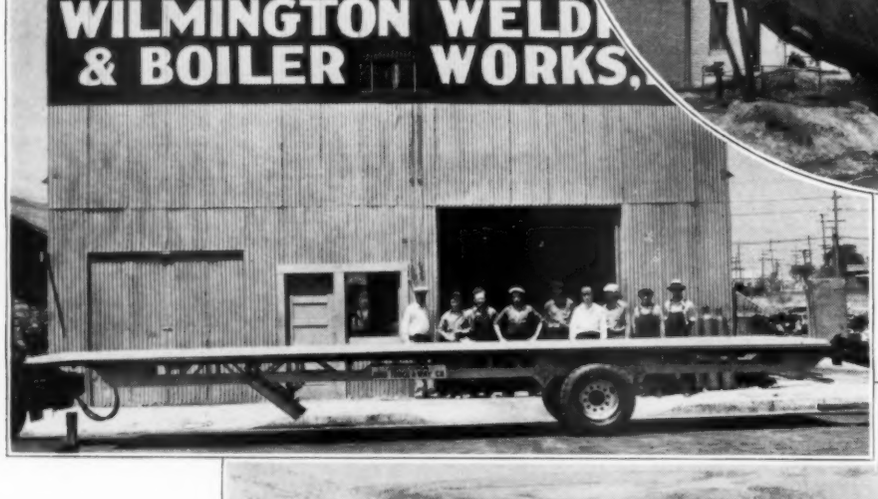
The other paper on the program was written by Capt. P. B. Dungan, of the United States Navy, on the subject of "Data on the All-Welded Vessel *YF-221*." The *YF-221* is an all-welded freight lighter recently constructed by the Navy Department at the Brooklyn Navy Yards, New York. This paper, which gave a very interesting and comprehensive description of welding in ship building, was scheduled for presentation by V. M. Goode, chief master mechanic on the repair ship *U.S.S. Medusa*, but on account of illness, Mr. Goode could not be present, and the paper was read by J. C. Blake, district manager in Southern California for the Victor Welding Equipment Co.

In addition to other business conducted at the meeting, Mr. Laulhere, chairman, also announced appointments of new committees for the coming year, including Program and Membership Committees, committees for the development and advancement of various phases of welding in the different industries, etc.

WELDING NEWS IN PICTURES - - -

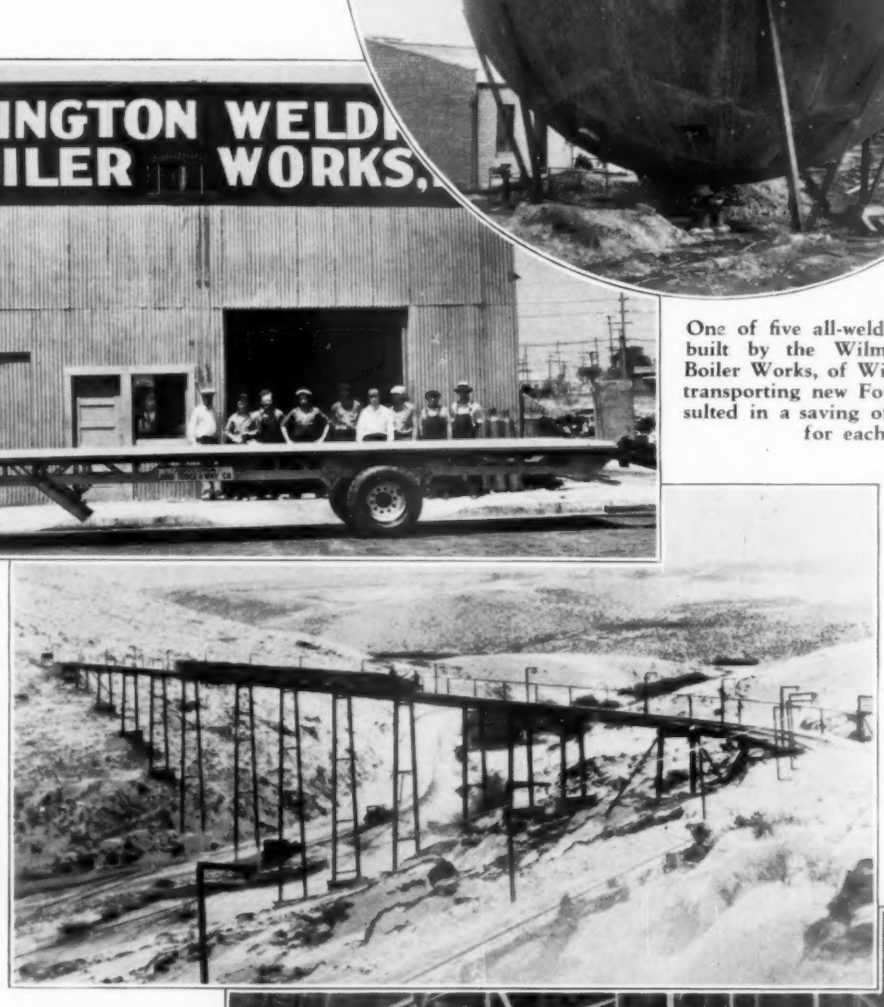
A 45-ft. Hortonsphere with all seams butt welded, recently erected by the Chicago Bridge & Iron Works. View taken just after erection but before painting. The Hortonsphere shown on page 12 of the February issue of *The Welding Engineer* was a riveted structure and not welded and was an earlier job than the one shown here.

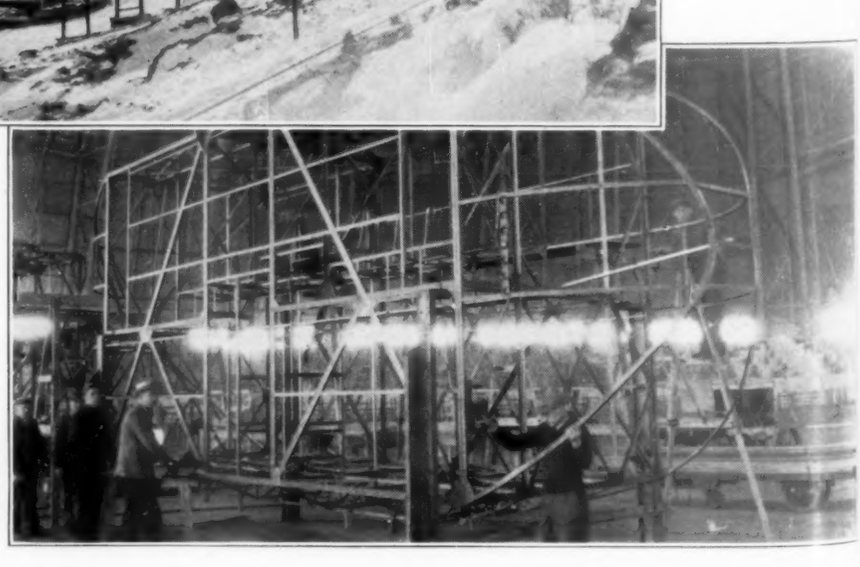




One of five all-welded truck-trailer units built by the Wilmington Welding & Boiler Works, of Wilmington, Calif., for transporting new Ford cars. Welding resulted in a saving of 2000 lb. in weight for each trailer.

With 10-in. scrap pipe and scrap rail, all welded together, a western coal company built this 393-ft. bridge. The only new metal utilized was 135 lb. of General Electric Type F electrode.





All-welded framework of one of ten rocket cars being made by the Goodyear Zeppelin Corp., Akron, Ohio, for the Sky-Ride at Chicago's Century of Progress Exposition (1933 World's Fair). Each car has a capacity of 36 passengers and pilot.

Training

Effect of Training on Welding Skill

Data on performance in welding based on hours of instruction were recently obtained as the results of tests of two welders, and reported in a thesis by C. R. Nailler and J. S. Anderson, students in the Case School of Applied Science, Cleveland, Ohio. The purpose of these tests was to determine the effects of systematic training on performance or skill in welding, and the data for each welder were plotted in the form of curves.

Forty-eight test plates, 6x8 in. in size, were cut out of ⅜-in. mild rolled steel and prepared for welding by machining a 30° bevel on one of the 8-in. sides of each plate. Almost all the instruction and practice were obtained at the welding school of The Lincoln Electric Company, under the supervision of Mr. Madson, welding school head.

Welder No. 1 received 3 hours of instruction and practice during his first day at the welding school. Following this 3-hour period, this student made his first test specimen by butt welding together the beveled edges of two of the prepared plates. On his second day at the welding school, this student received three more hours of instruction and practice, which was followed by the making of the second test weld. This procedure was followed every Monday, Wednesday, and Friday for a period of four weeks, at the end of which time welder No. 1 had accumulated 36 hours of instruction and had made a total of 12 test welds, each specimen representing his work at different and definite intervals of his welding experience.

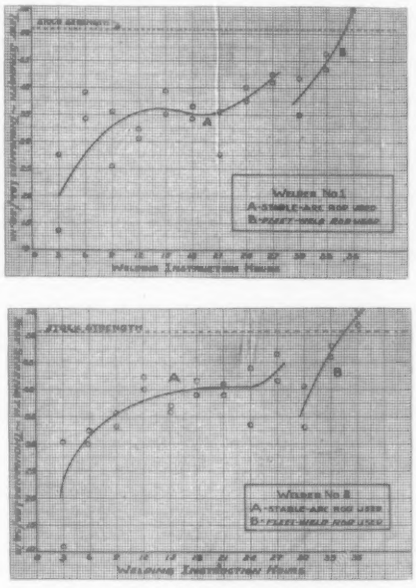
A similar program was adopted by welder No. 2, except that he reported for instruction and practice on only Mondays and Fridays for a total period of six weeks. Therefore, welder No. 1 received 36 hours of experience over a period of four weeks, while welder No. 2 received his 36 hours of experience over a period of six weeks.

Both apprentices used 3/32 in. Lincoln Stable-Arc electrodes in making their first nine test welds, and for the last three test welds both men used Lincoln Fleetweld rods.

The welded section of each specimen was machined down to a definite thickness, and the specimen was then sheared into four strips 2 in. wide. Two of these strips were tested and the results from the data from which the accompanying curves were plotted. Two ¼-in. holes were drilled in the welds of all the Fleetweld strips to insure the breaking of the specimens in the weld.

A marked similarity is evident between the curves of both welders. These curves show that the rate of learning is most rapid during the first 9 hours of instruction and practice. The authors of the thesis point out that "during the initial part of the experience, the apprentice has only to learn the bare and most obvious essentials of welding which necessitate little experience to recognize and adjust oneself to," and that therefore it is natural to expect a high rate of learning during this period.

After 9 hours, however, both welders reached a temporary maximum known as the "plateau," and little or almost no progress is made during the next 15 hours. According to the diaries of both



Performance Curves of Welders No. 1 and 2, Based on Strengths of Weld Specimens.

welders, it was during this period that they became aware of the finer points in the art of flat electric welding. More definite regulation of the arc, together with a more exact degree of penetration into the base metal, were some of the finer essentials learned. An examination of the breaks in the test welds made during this period show better penetration and greater homogeneity of the weld metal.

Near the end of the test, the curves rise again. During this period both students evidently were learning to put into practice the more intricate essentials of the art. Notwithstanding the difference in time covered by the training periods, the curves show no substantial difference in the rate of progress by both welders.

Since two test specimens were sheared from each test weld, the strength of the welds for each period of learning is indicated by two points, the mean of which establishes one point on the curve. It will be noticed that, in the main, the difference in strength of both specimens decreased as the students' experience increased, thus indicating progress in making homogeneous welds.

Due to lack of experience with shielded-arc electrodes, the first welds made with Fleetweld rod showed lower strengths than the maximum reached with the light-fluxed rods. However, with instruction and practice, the weld strengths obtained increased rapidly and at the end of 6 hours of training the strength obtained exceeded that of the parent metal.

It is not pretended that all apprentices will show the same or similar results to those cited above. However, because of the marked similarity in the results in the case of both students, it can be stated that the general trend of the average apprentice in learning to weld should follow to some extent the path pointed out in the tests, conclude the authors. That is, the conscientious apprentice will learn rapidly at first, then probably reach a temporary stagnation in progress, and finally, after observing the more intricate essentials of the art, reach greater perfection by application of these essentails. The authors point out that the curve of learning shows considerable similarity to the results of tests of students with gas-welding equipment conducted some time ago by James R. Griffith, of Oregon State College.

All-Round Welders Must Know Fundamentals

By A. G. ODELL
Lecturer and Director of Welding
Opportunity School, Denver, Colo.

A teacher in welding must know the fundamentals of the art if he would imbue the student with such knowledge as will enable him to do the correct thing under any and all circumstances. In addition, the teacher must have had teacher training. No matter how much the teacher knows or how good a workman he may be, his value as an instructor depends on how thoroughly and rapidly he can impart what he knows; imparting, not doing, is his job.

One of the most common errors of the untrained teacher is to imagine that telling is teaching or that showing is instructing. The successful instructor thoroughly knows what he is to teach, and he is able to impart this knowledge effectively. In the industrial training of welders, this means that the instructor must know two trades; he must know his own trade so he will know what to teach, and he must know the teaching trade so he will know how to teach. Without a thorough command of both trades, he is a failure.

In our shop classes in welding, we use no jobs to teach the fundamentals, but employ only exercises. For example, if the student wants to learn pipe welding, we teach him to weld on all thicknesses of plate steel in all positions, (flat, vertical, horizontal, and overhead) and in all directions (backward, forward, upward, downward, and toward and away from himself), using either hand and using a mirror for close quarters. Having completed the course, the welder then can weld any kind of rolled or drawn steel pipe or plates, whether it be a cross-country pipe-line job, steam pipe, water pipe, airplane tubing, building a steel tank, welding flues in a boiler, welding steel furniture, or the like.

The welder's job, irrespective of what the particular application might be, is to unite the steel sections while in the molten state, without seriously modifying the chemical, physical, and mechanical properties in the deposited and parent metals. With a certain degree of knowledge of chemistry, metallurgy, physics, heat treating, etc., together with shop practice, the welder can weld mild steel, irrespective of the shape or the function of the welded part. The ability to weld all other metals is taught in the same way.

With such a course of instruction, the student does not require re-training for each particular job. If it were necessary to make a separate and special study of applying boiler patches, welding steel tanks, welding broken automobile frames, welding structural steel, welding steel pipe, and all other jobs that the welder might be called on to do, the student's instruction would never end.

By limiting instruction and training to certain fundamental facts that control every job fabricated from any metal by the fusion welding processes, or salvaged by the fusion processes, much valuable time is saved. These fundamental facts are:

(1) A weld resists or allows tension, compression, tortion, bending, alternate stresses, shock, shear, or surface wear, or adds to a decorative scheme, or smooths pitted surfaces, etc. The weld's ability to accomplish any one or any combination of the foregoing is known as its properties. The properties are determined by the chemical and structural makeup of the metal.

(2) The chemical makeup is influenced by oxidation, vaporization, carbonization, introduction of impurities and alloys, etc. The structural makeup is influenced by working, heat treating, preheating, annealing, normalizing, etc. Relatively few metals and alloys are used separately, and endless combinations of metals and alloys are in every-day use. A knowledge of metals is more necessary today than ever before.

With this knowledge at hand, the welder will analyze each job in much the following manner:

What is the chemical makeup of the parent metal?

What is the structural makeup of the parent metal?

How is the parent metal affected by heating, cooling, and working?

What chemical elements or compounds will benefit the weld, and which will harm the weld?

What is the functioning factor of the piece being fabricated or salvaged?

What is the purpose of the weld in this particular job?

What allowance is to be made for expansion and contraction in order to avoid warping, cracking, and residual stresses?

Will heat treatment be beneficial or necessary?

Having answered these questions, the welder can then choose the proper materials and equipment to make the weld and proceed without seriously modifying the chemical, physical or mechanical properties of the deposited and parent metals and be assured that the weld will be of the desired quality and strength.

Shop training in the school or training in manipulation on the job teaches the welder to handle his tools and equipment to the best advantage, but nothing else. A knowledge of physics, metallurgy, chemistry, heat treating, and of welding equipment, supplies and procedure is necessary. The first impression that such a course is too involved and too technical and theoretical is not borne out by our experience.

A well planned course can cover the ground and make the facts of chemistry, metallurgy, physics, etc. an indispensible aid to the student welder, practical welder, or executive. The student is not expected to remember all the thousands of details involved in the analysis of some jobs, and therefore he makes notes in the science classes and uses handbooks to refresh his memory, to act as a check against error, and to be referred to for further data and tabulations.

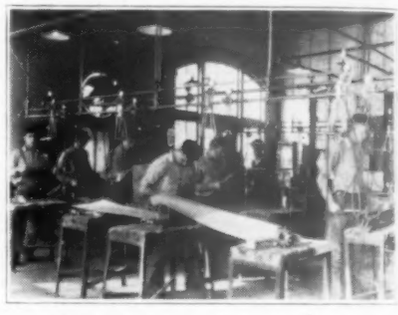
Welders properly trained are able to analyze 99 per cent of the jobs they are given to do, and they can plan their procedure to suit the requirements. The untrained man will be able to analyze only one or two types of materials, if any at all. The employers of welders should rate them upon their knowledge of the sciences relating to fusion welding and not upon the number of years they have been working as welders.

School instructors can be of much aid in the development of correct procedures and joint design. Eighteen years ago, before I entered the teaching profession, I advocated and practiced backward welding, holding the rod in the pool with no movement of the blowpipe but moving the rod instead. I also advocated flush welding by either the oxyacetylene or electric-arc process, because I found that the excessive heat needed for reinforcement weakened the metal next to the deposit. These ideas have been furthered in my contact with students in my classes and with instructors who come under me for training.

For those who are responsible for the instruction of welders, I would recommend the following two books: "The Instructor, the Man and the Job," by Charles R. Allen; and "Vocational Education in a Democracy," by C. A. Prosser and C. A. Allen.

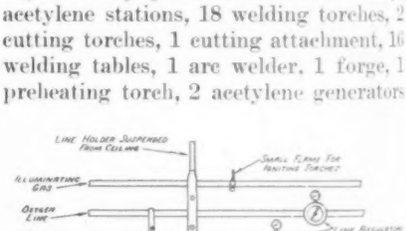
Four-Year Course in Welding

A 4-year course in welding instruction is now being offered by the New Bedford Vocational School, 415 Ash St., New Bedford, Mass., of which W. R. Mackintosh is director. At present 18 students are enrolled in this course. Instruction is



Welding Class in New Bedford School.

given 40 weeks per year and 7 hours per day. The equipment consists of 16 oxy-acetylene stations, 18 welding torches, 2 cutting torches, 1 cutting attachment, 16 welding tables, 1 arc welder, 1 forge, 1 preheating torch, 2 acetylene generators



Method of Suspending Gas Lines From Ceiling.

Design of Welding Table.

(of 100 and 300 lb. capacity respectively), and 1 sludge tank.

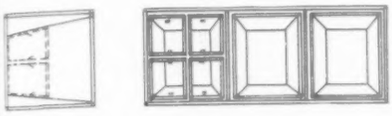
The line regulators are suspended from the ceiling and are 6 ft. 6 in. above the floor. With this location of the stations, the rubber hose does not drag on the

floor, and it comes in from back of the welder working at one of the tables. The welding tables are in the center of the shop.

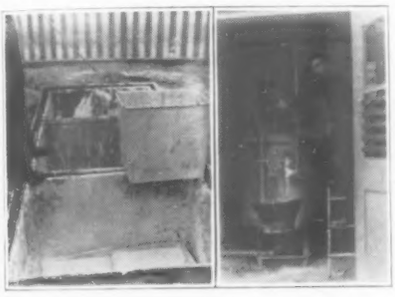
The sludge tank makes a very convenient method of handling the sludge from the acetylene generators, and does away with a messy yard. The tank is made up of three compartments, each holding four buckets, as shown in the photograph and the sketch.

The shop instruction covers eight terms, as follows:

1st Term: Oxyacetylene welding of steel up to 3/8 in.; cutting steel; bronze welding steel; simple forging.



Drawing of Sludge Tank.



Sludge Tank (Left) and One of Generators (Right).

2nd Term: Oxyacetylene welding of steel 3/8 in. and over; welding cast iron; bronze welding cast iron; forging.

3rd Term: Oxyacetylene welding of brasses; cutting cast iron; lead burning.

4th Term: Oxyacetylene welding of aluminum, copper, and alloy steels; welding, using the forge.

5th Term: Oxyacetylene welding of stainless steels, aluminum alloys, and copper alloys.

6th Term: Oxyacetylene welding of steel and wrought-iron pipe.

7th Term: Oxyacetylene welding of cast-iron pipe; metallic-arc welding.

8th Term: Carbon-arc welding; thermit welding; arc welding pipe.

The related work covers a period of four years and consists of the following subjects:

Trade science; mathematics (fractions, mensuration, algebra, plane geometry); drawing (free hand, isometric, intersections and developments, pipe-template layout, mechanical); English; civics; history; trade geography; physics; and metallurgy.

Four evening practice courses in welding are offered, as follows: arc-welding practice course, 150 hours; pipe-welding practice course, 200 hours; general practice welding course, 160 hours; and advanced practice welding course, 100 hours.

These practice courses are divided into a stated number of accepted hours and a student is given a certificate on completing the course. For example, the 100-hour advanced practice welding course is divided as follows: welding copper, 10 hours; welding aluminum, 35 hours; welding brass, 10 hours; welding bronze, 10 hours; welding steel and aluminum alloys, 25 hours; hard surfacing, 10 hours. These evening courses are offered to the men in the trade or allied trades and are called trade extension courses.

The certificate issued those completing a course is very conservative in its statement. It certifies that the student has practiced welding for a certain length of time which is equivalent to the number of hours that the same amount of work could be done in the trade. As an example, the student may have to work 18 actual hours before he receives the credit of 10 hours for copper welding.

The evening classes have an enrollment of 60 men. There are two instructors—one in the shop and one in the class room. The group is divided into six sections, three sections meeting on Monday and Wednesday nights and the other three sections on Tuesday and Thursday nights. One of the three sections goes to the class room every third night. A small fee is collected from each man when he is in the shop to pay for the excess stock he uses.

Repairing Castings

$600 Saved by Welding Broken Stone Crusher

By W. E. ARCHER

A recent welding job costing only about $15 saved a rock crusher contractor near Boulder City, Nev., about $600. This repair job consisted of the welding of the main frame of a No. 3 Universal Stone Crusher used in supplying rock material in connection with the Hoover Dam construction work.

The front lower base of the frame was broken off about five inches back from the end, as can be seen in Figure 1. The broken casting ranged from 3 to 6 in. in thickness, and was about 24 in. long. Pieces of the casting are indicated by an arrow in Figure 2, which also shows the broken edge. A crack about 8-in. long in the middle of the broken piece was also welded, as can be seen in Figure 1.

The welding of this frame was entirely by the electric arc. The main weld was made by veeing out both sides and studding. Holes were drilled stagger fashion in both beveled edges about every 2 in. and studs were inserted in these holes preparatory to the welding operation. This insured greater strength, which was necessary at this point in view of the fact that it is in close proximity to the jaws of the crusher and receives a great amount of the concussion in the crushing operation. Six beads were required in building up the weld to finish the job, which consumed approximately 30 lbs. of welding metal. The crack in the middle of the casting, as seen in Figure 2, was welded by first veeing in the customary manner and building up by the electric process. No preheating whatever was required on this job, which was finished in about 6 hrs. of welding time.

This repair was made by the Brown-Bevis Co., of Los Angeles, Calif., dealers in highway and general construction equipment, and was done for Fred Monson, of Las Vegas, Nev., whose plant is near Boulder City, the nearest town from the dam site.

The cost of repairs including the work of reassembling was about $55. The repair job saved the contractor from buying a new crusher, which would have cost about $675. Thus an actual net saving of more than $600 was realized by welding

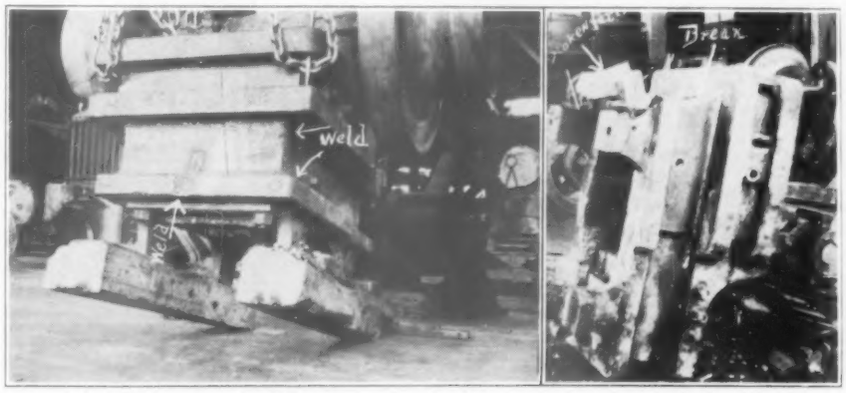


Fig. 1 (Left) and Fig. 2 (Right) Showing Repaired Casting.

the broken casting. The welding operations were supervised by T. S. Eley, shop superintendent and welding foreman for the Brown-Bevis Co.

Welding Makes Savings in Repair of Large Presses

The Menna Welding Co., of Toledo, Ohio, recently completed the repair of two large presses with considerable saving compared with the cost of new castings. In one case, the broken frame of a press that had been engaged in stamping operations had to be repaired with the utmost precision inasmuch as the frame carried the guide and other mechanism that determined the accuracy of the operation of the press. A new frame for this machine would have cost approximately $300, while the total cost of repairing the old frame by welding was but little more than one-quarter that figure. Seventy-five pounds of ¼-in. welding electrode was used on the job. Since its repair, the press has resumed regular operation.

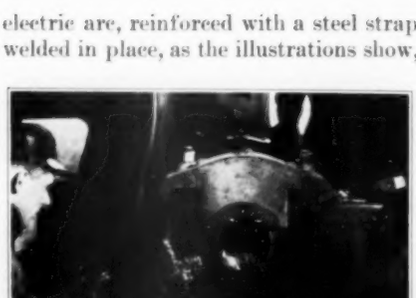
In the second instance, the Menna Welding Co. was awarded the job of repairing the frame of a 12-ton press that had broken at the crankshaft bearing. The section to be welded was approximately 14 in. in thickness. About 250 lbs. of electrode was used and the total cost of the job amounted to only one-eighth of the cost of a new frame, a saving of over $2000. General Electric Type "A" welding electrode was used on both jobs.

Carbonator Machine Base Repaired by Welding

When the cast-iron base forming part of the bearings on a carbonator machine was broken off, the Benjamin J. Baldus

Broken Base and Bearing Caps.

Welding & Radiator Shop, of Holland, Mich., was called in to make the repair by welding. The broken parts were faced with steel studs and then welded by the electric arc, reinforced with a steel strap welded in place, as the illustrations show,



Base Repaired by Welding.

using Lincoln "Blue" rod. The base is a hollow casting, measuring 18x9 in. at each break with a wall thickness of 1¼ to 1¾ in. It was not necessary to machine the bearings after welding.

The two bearing caps, each of which is held in place by a bolt at each end, were also fractured, both ends being broken on one cap and there being one break in the other cap. These were repaired by oxyacetylene welding.

The entire welding job, with two welders working, was completed in 23 hours. The work was done for the Holland-St. Louis Sugar Company, Holland, Mich.

Oxyacetylene Cutting

Cutting Chrome-Nickel Steel Risers

Chrome-nickel steel risers, particularly that variety known as the "18 and 8," can be successfully cut with the oxyacetylene torch, said R. B. Aitchison, of the Oxweld Acetylene Company, in a paper read before the International Acetylene Association convention in Philadelphia, November 16-18, 1932. "I do not wish to infer that all chrome alloys can be cut," said Mr. Aitchison, "neither does such cutting refer to the severing of plate."

"The first work done by the oxyacetylene cutting process used a steel feeder rod to aid the oxidation process," Mr. Aitchison pointed out. "By this is meant that a steel or iron rod was fed into the kerf while the cut was being made. Obviously this could only be applied to small risers because it necessitates using the blowpipe with one hand while the rod is fed in by the other. The cuts were slow and thus expensive.

"The steel foundries demanded something better than any of these methods and their demand was met by the development of a satisfactory oxyacetylene cutting technique. As a result, the cutting of chrome nickel risers has been done on a commercial basis over the past three years. Before describing the procedure, it will be of interest to review the problem for a moment.

"We are dealing with an alloy very much more resistant than plain steel to oxidation by ordinary atmospheric conditions or that hastened by high temperature. The alloy obtains this characteristic from the chromium and nickel, both of which, generally speaking, are impervious to oxygen attack. The first point to remember, then, is that the chromium and the nickel will defeat the oxygen jet under ordinary circumstances and with the usual cutting manipulation.

"To go back to cast-iron cutting again for a moment, most of you are undoubtedly familiar with the blowpipe operation which through weaving from side to side enables the iron oxide to wash out particles of graphitic carbon, which, if the normal blowpipe manipulation were used, could be counted upon to defeat the cutting process. So, too, in the cutting of 18-and-8 risers, the chromium and nickel particles will stop the oxidation if the ordinary blowpipe manipulation is used. To swing from side to side would mean a very wide kerf, consume too much metal and thus too much oxygen—for this is a production operation, not a scrapping process, and therefore cost must be considered of primary importance.

"The casting is presumed to be on the cleaning floor, and the blowpipe must now be made ready. As we are going to need a lot of heat, it is recommended that a size larger nozzle or tip be used than would be the case were the casting of plain steel. The oxygen hose should preferably be ⅜ in. in diameter in order to secure ample volume. The tip or nozzle should preferably have six preheating jets rather than the usual four or less. The oxygen cutting pressure needs to be increased perhaps 15 to 20 per cent more than would be the case were the casting of ordinary steel.

"In connection with this cutting, I am speaking of experience with an injector-type blowpipe in which the oxygen aspirates sufficient acetylene to maintain a neutral preheating flame. The blowpipe is now adjusted so that the preheating flame will never be oxidizing when the cutting jet is wide open. A mere feather of acetylene in the preheating flame is not objectionable—in fact it may be of help to the beginner—but a distinct and heavily carbonizing flame is detrimental to the cutting action in that the preheating temperature is lowered.

"The cut is started horizontally across the top surface of the riser, and it progresses downward in a vertical plane from the upper surface to the lower. During the cutting, the blowpipe is moved up and down.

"In starting to cut, the operator first preheats the top of the riser across what is going to be his line of cut. It is necessary to do this in order to establish a straight and easy kerf. If this isn't done, then there is quite some likelihood of the kerf going wild and a pocket forming, with the result that through cutting will stop. When the line of cut has been preheated to a dull red, the operator starts to concentrate his preheat at the point where he will start cutting. Very quickly the spot will become white and start to melt. The blowpipe tip is directed in a horizontal plane across the top.

"He will now move the blowpipe so that the inner cone of the preheat will be perhaps 3/16 in. away from the face of the riser, and as he does so turns on the cutting oxygen. If the preheating has been sufficient, the cut will start and the operator will be able to look right into the whole of the kerf and watch his progress. The slag will be much more incandescent than is the case with plain steel, and will crackle and spark violently. The operator, with gentle but speedy up and down motions, will start to bite through the riser. The noise will resemble that occasioned by the rapid sawing of hard wood. He must keep these motions up and down and not swing from side to side, otherwise he will consume too much time and material.

"He will notice that the cut is not always sustained at the point directly in front of the blowpipe tip. This is probably due to the fact that the cutting oxygen is still cool even after passing through the preheating flame; and this accounts for the suggestion made to keep the inner cone a short distance from the face of the riser. The operator should not stop his work because of this refractory spot as he will notice that this point will become oxidized and carry off as he goes along, he unconsciously varying the distance between the blowpipe tip and the face of the casting to achieve this result. If the operator stops during a cut and it cools off below red, it will be somewhat difficult to pick up the cutting smartly, due undoubtedly to the fact that there is now a surface layer of slag added to the kerf.

"In starting an operator out on this work it is advisable, in order to overcome the psychological factor of 'it can't be done,' to use a larger nozzle or tip and more oxygen and acetylene than is really necessary. The immediate thing to bear in mind is that it can be done; and once the new operator is over this hurdle, the cutting down of pressures and use of correct tip size can and must go forward, because cutting chrome-nickel steels is more expensive than cutting plain carbon steel, but how much more will depend very largely on how much attention and aid we of the oxyacetylene industry give to our steel foundry customers.

"A skilled operator will sever a 6x6-in. chrome-nickel steel riser in 3 to 3½ minutes' cutting time, which indicates that there is not a great deal of difference in time between ordinary steel riser cutting and the cutting of the chrome-nickel risers once a man has learned the practice. The kerf made in this cutting is about one-third wider than that of carbon steel of same diameter. But the cut surface will, of course, not be as smooth as in plain carbon steel work, because of the need for hand movement in cutting chrome-nickel risers.

"The cut can come within reasonable distance of the casting proper. Again, though, judgment must be used in the beginning, for it is far better on the first dozen castings cut to leave a 1½-in. stub for finish grind than to take off the riser to within ¼ or 3/16 in. and take a chance of spoiling the casting through cutting in. Here again experience will show the individual how near he can go.

"The cutting of chrome-nickel risers should be done prior to any heat treatment given the casting. Very small risers, 1 to 1½ in., can be nicked from each side to a depth of about 25 per cent of the total thickness and flogged while hot. If this flogging is done directly after nicking, there will be much less danger of damage to the casting, and the nick on either side tends to make certain that the break will be clean.

"The suggestions made here should not be taken as inferring that this is the only method and manipulation for this work," concluded Mr. Aitchison. "They are given because the author knows from experience that this method works. Modifications will come to the individual with practice and experience."

Effect of Oxygen Cutting on Physical Properties

(Extract from paper read by C. G. Bainbridge before the November, 1932, meeting of the Institution of Welding Engineers, London, England, and reported in "Industrial Gases.")

All mild steels containing up to 0.3% carbon can be quite easily oxygen cut, and the surface of the cut will be readily machinable after cutting. The general effect of oxygen cutting is to change the normal ferrite and pearlite condition to sorbitic pearlite with ferrite envelopes at the cut edge; this results in a slight toughening at the cut surface, the total increase in Brinnell hardness on mild steel being only 30 to 40 points. There is also an increase of carbon near the surface of the cut, but this carbon change usually penetrates inwards for only about half the total depth of effect.

This is a structural effect similar to that produced by water-quenching and tempering steel of the same composition, and is largely due to the chilling effect of the comparatively cold mass of metal at the back of the cut surface. Cuts made on metal which has been preheated show only a superficial film of toughened metal. On ordinary mild steels of 20 to 30 tons tensile strength and 0.18% to 0.25% carbon, the maximum depth of change of structure extends inwards from the cut surface for not more than ⅛ in. and generally only for 3/32 in. or 1/10 in. This applies to material up to 3 or 4 in. thick, but the depth of effect varies with the material thickness, and may be nearly ¼ in. on material 6 in. thick. This is the maximum depth of effect, at which point the steel becomes normal in structure and hardness. It will be seen that oxygen cutting has no detrimental effect on the material, provided it is a steel not adversely affected by the application of heat.

If the article is normalized after cutting, all traces of cutting effect will be removed, but unless the use of the article makes machining necessary, jobs cut from steel containing up to 0.3% carbon can be put into service exactly as produced. It is recommended that steel containing 0.3% to 0.4% carbon be preheated to about 500°C. (visible red in daylight) before cutting. Advantages can be obtained by employing oxygen for cutting manganese steel. Oxygen cutting has no detrimental effect, and perfectly smooth and accurate cuts are obtainable, with no hardening of the cut surface. Some mechanical tests made on oxygen-cut samples gave interesting results.

Fourteen tests, carried out to ascertain the effect of oxygen cutting on the tensile strength of mild steel, gave the following average results:

	Oxygen Cutting	Machine-Tool Shaping
Yield point, tons per sq. in.	17.50	16.50
Tensile strength, tons per sq. in.	24.95	24.40
Elongation, per cent in 8 in.	21.95%	23.2%
Reduction of area	59%	58.8%

Thus the ductility is not affected to any great extent, while the yield point and tensile strength are slightly increased, which is probably due to the slight toughening action of the cutting on the surface of the metal.

In order to investigate further the effect of oxygen cutting on the ductility of the material, some bend tests were made in the following manner: A piece of mild steel 2 in. thick was cut into a strip about ⅝ in. wide, with oxygen cuts on both sides of the strip; the strip was then bent round a ¾-in.-diameter pin, so that the cut surfaces were in tension and compression, respectively. No signs of cracking occurred until the piece had been bent through almost 180°.

Book Reviews

Rail Joints

COMMITTEE ON WELDED RAIL JOINTS—FINAL REPORT. 6x9 in.; 358 pages; 251 illustrations and 20 tables. Paper binding; price $1.00. Published by Committee on Welded Rail Joints, Engineering Societies Building, 29 West 39th St., New York, N. Y.

The Committee on Welded Rail Joints is a joint committee of the American Electric Railway Association and the American Bureau of Welding, and has operated in cooperation with the National Bureau of Standards. For ten years the committee has been conducting an extensive series of investigations seeking to improve and standardize the making of welded rail joints. Seven progress reports have been issued by this committee in the past; and now this, the final, report brings together in orderly arrangement all the data compiled by the committee. This report includes all the important material in the progress reports though some illustrations, comments, and supplementary reports have been omitted to save space.

This final report is divided into the following parts: Introduction, Summary of Results, "Present State of the Art" Series of Tests, Development Program of Seam Welded Joints, Otheograph and Telemeter Investigations, Metallurgical Investigations, Strain Gage Tests, and Miscellaneous Investigations and Tests. Tests were made on bar-welded joints, butt joints, cast joints, thermit joints, Apex joints, and seam-welded joints. The tests were for electrical conductivity, ultimate tensile strength, deflection under load, and also included drop tests and repeated impact tests.

Engineering Career

ENGINEERING: A CAREER — A CULTURE. 6x9 in.; 61 pages. Paper binding. Published by The Engineering Foundation, 29 West 39th St., New York, N. Y.

Intended as a guide to young men, parents, and teachers, this pamphlet deals with the professional functions of the engineer in each of the major divisions of engineering. It was prepared by the Education Research Committee representing the American societies of civil, mining, metallurgical, mechanical, electrical and chemical engineers, the Society for Promotion of Engineering Education, and The Engineering Foundation. The opportunities of engineering as a whole are described, and the reader is given an idea of the personal qualities required if he would be successful in the profession. The various chapters are authoritative and they have been prepared with great care.

Lincoln Prize Papers

DESIGNING FOR ARC WELDING. Second Lincoln Arc Welding Prize Competition Papers. Edited by A. F. Davis. 6x9 in.; 420 pages; replete with illustrations and tables. Cloth binding; price $2.50. Published by The Lincoln Electric Company, Cleveland, Ohio.

The publishing four years ago of the prize papers submitted in the first Lincoln prize competition was a highly valuable contribution to the literature on arc welding. This present volume of papers submitted in the second competition will be welcomed by those engaged in welded fabrication who are seeking means of cutting costs and increasing the reliability and usefulness of the welded product. Each of the nineteen papers presented in this book gives actual cost figures and explains how the savings were obtained.

The five sections into which the book is divided and the titles of the papers presented in each section are:

Machinery: Manufacture of ordnance at Watertown Arsenal revolutionized through arc welding; a 500-ton precision press (analysis of design, construction by welding, economies effected); electric-driven trucks of arc-welded tube construction; application of arc welding in the manufacture of a paper box machine; the redesign of a dough mixer; design details of arc-welded fan structures.

Ships: The design and construction of an arc-welded naval auxiliary vessel; special ship of welded structure for the direct export of bulk cargoes from river ports over sea to foreign European ports.

Buildings—Bridges—Houses: The application of arc welding to the design of steel buildings for the resistance of earthquake forces; strengthening of weak iron and steel bridges by means of electric welding; the arc-welded steel-frame house; welded steel floors; and arc-welded sheet-steel floor adaptable to residence construction.

Large Containers: Arc-welded steel-plate surface condensers for land use; arc welding of steel cars; a comparative study of a riveted type and a welded type of purifier.

Piping and Fittings: Arc-welded piping and pipe fittings; arc-welded steel expansion joint; the use of arc-welded alloys to arrest corrosion.

Weld Metal and the Arc

ELECTRIC WELDING AND ELECTRIC WELDS. The Institute of Research, Lehigh University, Circular No. 86. 6x9 in.; 42 pages; 30 illustrations. Paper binding; price 20 cents. Published by Lehigh University, Bethlehem, Pa.

This is a collection of four papers giving the results of research conducted at Lehigh University and other laboratories into the nature and characteristics of the arc and weld metal. Three of these papers were presented before the American Welding Society and one before the American Institute of Electrical Engineers. The papers are entitled: Researches in Arc Welding; Metal Deposition in Electric Arc Welding; Concerning Crater Formation; A Corrosion-Fatigue Study of Welded Low-Carbon Steel.

Structural Welding

ARC-WELDED FRAME STRUCTURES. By Gilbert D. Fish. 6x9 in.; 401 pages; 211 illustrations and 17 tables. Cloth binding; price $5.00. Pulbished by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y

A great deal of information has been published in periodicals and handbooks regarding structural arc welding. The author of this volume, who is a well-known consultant in the structural welding field, has taken the meat of this material and put it in orderly form, together with records from his own valuable experiences. This book will be welcomed by structural engineers, designers and contractors alike who wish to be informed on the subject of structural welding. With many municipal structural codes at the present time undergoing revision, this book is timely.

The book begins with a general review of welding applied to buildings and bridges, and information of a general nature is given regarding welding equipment, procedure, nomenclature, and inspection of welds. A chapter on specifications includes the entire building code of the American Welding Society, edition of 1930, together with appendix, and the author's own specification for arc-welded bridge connections. The physical properties and stress analysis of arc welds are discussed in detail, and descriptions are given of typical designs of welded connections. Many strength tables are included for design purposes.

In Chapter VI arc welding is discussed from the standpoint of economy. This is followed with a review of construction operations, and a chapter on estimating of material, time, and costs. Conventional methods of detailing built-up members are described, and several typical shop drawings are reproduced. A chapter on supervision includes such pertinent topics as specifications, checking, inspecting, qualifying operators, and procedure control. In the concluding chapter the author makes pertinent comments on structural welding based on his experiences.

The many illustrations and diagrams add clarity to the text, and show great care in their preparation. A comprehensive index makes this book valuable as a reference work.

· E D I T O R I A L ·

Confidence—The Corner Stone of Recovery

● The developments in the two weeks ending March 11th were a clear demonstration of what chaos a virtually complete loss of confidence in the future can cause. The conditions which created that irrepressible fear have now been largely corrected through vigorous and speedy action on the part of the new administration in Washington, with the result that a sincere feeling is evident everywhere that we are now well on the road to recovery, even though the mile posts are passing by too slowly for most of us. When confidence is lacking, increases in wages or in employment are not a natural result, and, having to be forced, they do more harm than good. That is one reason why some measures taken ostensibly to relieve the unemployment situation have been ineffective. The hue and cry that we must increase wages and employment by any means at hand if we would pull out of this morass is putting the cart before the horse. The truth of the matter is, harsh as it may seem to some, that as long as those who have wealth and those who receive wages will not spend any more than a pittance of their income or of their reserve cash, no amount of forced employment will remedy the situation. In the reviving of confidence, in which a balancing of the federal budget will play an important part, the fear that one has of spending his resources will disappear. Prosperity will return only as fast as wealth is increased to the point where the standard of living is high, but it is a well-known fact among economists that wealth can be created only by spending it, and history itself is a sufficient proof of that assertion. The return of confidence in itself, however, will not create spending. There must be that additional urge which comes from the belief of the buyer that he is getting value for his money. Artificial price increases can easily counteract the benefits of confidence. Industry should bear this important truth in mind during the next six months. While the present price structure probably would not support a normal volume of business, yet with increasing business, prices will rise as a natural result of increased demand for goods without having to be artificially inflated. There are some prices that even today are too low, and, on the other hand, there are many commodities and products whose prices are being maintained at a higher level than can be economically justified. The isolated individual known as the price-cutter cannot take heart from these statements. Price-cutters as a general rule are blind to costs, and unless they can be checked they may demoralize an industry. Even with prices low, no industry can justify operating expenses greater than income derived from sales. With confidence returning, with balanced budgets in the offing, and with industry putting out reliable products at a low price, the foundation is firmly laid for a recovery that will be speedy and economically sound.

This Matter of Repair Parts

● Is that regulator or torch or generator giving you the good service that it did when new? If it is not, before you condemn the device as being "no good," look to the repair parts you are using and make sure that they are of correct design and high quality workmanship and material. Manufacturers of welding equipment, in the main, gladly assume the responsibility of seeing that their apparatus gives the results that are claimed for it, and users of such equipment do not hesitate to hold the manufacturer to account if such claims are not substantiated in service. But it is plainly unfair for the user to expect the manufacturer to stand back of his claims for performance and service if parts have been substituted by the user for which the manufacturer of the equipment had nothing to do with design, workmanship or materials. When substitute parts are used without the manufacturer's knowledge or sanction, the manufacturer is by all rules of fairness relieved of the full responsibility for the performance of the equipment which was assumed at the time of sale. If the user substitutes inferior parts, he himself is responsible for any let-down in quality of work produced by the equipment. Responsible equipment manufacturers do not desire to shirk their duty in this matter, but many cases have been brought to their attention where replacement parts of inferior quality and imperfect fit have resulted in a lower standard of performance for which the equipment is being blamed. Equipment of the very best design and workmanship from the standpoint of performance, dependability, long life, and safety, will often produce poor results even in the hands of the most skilled workman, because parts of the equipment have been replaced by pieces of improper fit or low-grade material, which not only produce poor work but introduce a hazard that is not present when correctly designed parts are used. If you are substituting inferior repair parts for good ones, at least be fair to the equipment you are using and don't expect the maker of it to guarantee first-class results that can be obtained only with first-class tools and repair parts.

Make Hay While the Sun Shines

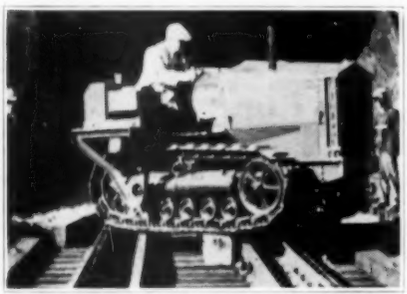
● It might be hard to convince some folks that the sun is shining. But those whose vision is adjusted to react to its rays do not need to be convinced. Today is a day of opportunity the like of which hasn't existed for a generation. Men of vision are taking advantage of the present to put their houses in order. They are investing wisely while prices are low; they are laying the groundwork for an organization that will command respect and will be a major factor in its field of operation. These men are making hay while the sun shines; the other fellows are waiting for the sun to come out.

New Equipment

Tractor-Mounted G-E Arc Welders

General Electric arc-welding apparatus mounted on tractors constructed by the Cleveland Tractor Company is now available for use in remote places where, heretofore, it has been difficult to supply current to the desired point of welding.

The weight of the arc welder does not materially affect the stability of the tractor, the load being carried directly on the heavy chrome-nickel steel shaft which rests in the track frame of the machine. The mounting does not interfere with the drawbar and leaves the tractor free for any drawbar work. The equipment is particularly suitable for oil, gas, and water line construction and repair work, for repair work in construction camps in out-



Arc Welder Crossing Railroad Tracks.

of-the-way places, for structural steel erections, and for maintenance work on railroad frogs, switches, and bridges.

This General Electric arc-welding equipment affords the same features obtainable in other types of welding apparatus manufactured by the company, including few wearing parts, instantaneous voltage recovery, compactness, duplex voltage control, and other design and operating features.

Helmet Gives Protection When Sandblasting

Increased protection at a much lower operating cost is claimed for its sandblast helmet No. 32 by Willson Products, Inc., Reading, Pa. This new device is for the protection of workmen who employ such abrasives as sand or shot through a high-pressure air hose in cleaning various kinds of metal castings.

The large comfortable helmet is made of strong wire screen over which a special grade of rubber is electrically deposited. A resiliency is thus obtained, which permits the helmet to yield slightly under a barrage of abrasive, absorb the shock, and reduce wear to the minimum. The entire weight of the helmet, less than 10 lb., rests on the wearer's shoulders, permitting unusual comfort and full freedom of movement of head and neck.

Economy of operation is effected by the elimination of exit openings; all

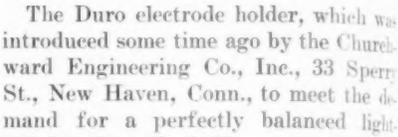
Willson Sandblasting Helmet.

breathed air escapes between the wearer's neck and the close-fitting fur collar. Air needs to be fed to the helmet only in an adequate quantity to permit comfortable breathing, usualy about 2 cu. ft. per minute.

The glass ports, properly placed to permit good vision, are hermetically sealed and protected by monel wire screens. By removing the fur collar dust seal from inside, the helmet can be sterilized with boiling water, steam or chemicals.

Electrode Holder With Solderless Connection

The Duro electrode holder, which was introduced some time ago by the Churchward Engineering Co., Inc., 33 Sperry St., New Haven, Conn., to meet the demand for a perfectly balanced lightweight electrode holder so constructed that the parts, especially the jaws, could



Cable Connection to Electrode Holder.

be easily and economically renewed, is now made with a special type of connection that employs no solder. As shown in the drawing of this novel connection, the flexible cable is introduced into the female member and held there while the male member is tightened in place. After the threads are caught, it is no longer necessary to hold the cable in place. The female member is held in a wrench or vise and the male member is tightened solidly.

One of the advantages of this connection is that the tapered end in entering rubs the cable clean of all oxide, scale, dirt and other foreign matter, and good electrical contact is made between the cable and the tapered end. The same principle is said to be employed in a new type of cable connector being introduced by the same manufacturer.

Trade Literature

"Manganal" electrodes and gas welding rods are described in several new bulletins recently issued by the Stulz-Sickles Co., 134 Lafayette St., Newark, N. J. The bulletin "How and When" explains that it is not necessary to reheat and water quench when welding 11% to 14% manganese steel castings with Manganal, and the bulletin entitled "Why?" tells the reasons why manganese steel castings repaired by welding are more dependable than new castings. The bulletin "What For and How" lists many applications of these rods.

Hobart arc welders or various types and mountings are illustrated and described in a new bulletin issued by Hobart Bros., Box U23, Troy, Ohio. Features of construction and design are illustrated and U. S. Navy oscillographs are reproduced to show the small override, quick recovery, and other operating characteristics. Another new bulletin descriptive of Hobart welders is entitled "Here's the Secret of Profitable Welding," and explains the advantages of arc welding in question-and-answer form, and lists 42 actual jobs, giving hours required, profit on the job, and amount saved the customer.

"Universal" arc welders are described in several new bulletins issued by the Universal Power Corp., 12367 Euclid Ave., Cleveland, Ohio. One bulletin is devoted to motor-generator sets, both portable and stationary; another bulletin

describes a portable road trailer type of gas-driven welding unit; and a third bulletin describes a heavy-duty arc welder mounted on a crawler-type tractor.

"Investigation of Fusion Welding" is the title of a mimeographed booklet issued by The Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn., and describing the results of examinations and tests of welded plates submitted by a number of manufacturers of fusion-welded unfired pressure vessels and manufacturers of welding wire. X-ray, tensile, ductility, and nick-break tests were conducted. The primary purpose of the investigation was to determine what physical properties might be expected in modern welding.

The A.S.M.E. Boiler Code, Section VIII, pertaining to unfired pressure vessels, has been reissued in a 1932 edition, which is available from The American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y., at a price of 65 cents. Incorporated in this new issue are all the revisions and addenda, including the new rules for reinforcement of openings, which were approved by the Council of the Society in August, 1932.

"The Metal Spraying Process" is the title of a booklet on the advantages and specific applications in various industries, published by The British Oxygen Co., Ltd., Victoria Station House, Westminster, S. W. 1, London, England. Another bulletin put out by the same company describes the apparatus and accessories used in the process.

A recent booklet on Enduro stainless alloys, issued by the Republic Steel Co., Massillon, Ohio, and reported in the February issue of *The Welding Engineer*, is designated as Bulletin 217, reports H. H. Oldham, of the company's advertising department, and not as Bulletin 217-B, which relates to a different publication of the company.

Welding on railways is featured in the February, 1933 issue of "Railway Engineering and Maintenance," 105 W. Adams St., Chicago, Ill. This issue is designated as a "Welding Number" and contains several articles devoted to the application of gas and arc welding to track and structures.

The catalog illustrated on page 33 of the February issue of *The Welding Engineer* carried the wrong legend under the cut. The illustration was of the stock list and reference book issued by the Central Steel & Wire Co., 4545 S. Western Ave., Chicago, Ill.

News of the Industry

Firms Exhibiting at Ohio Welding Conference

At the Ohio University Welding Conference held at Columbus, February 23rd and 24th, the following firms exhibited welding and allied equipment: The Industrial Commission of Ohio, Columbus; P. R. Mallory Co., Indianapolis; The Welding Engineers, Columbus; The Gas Products Co., Columbus; Capitol City Welding Co., Columbus; Imperial Brass Manufacturing Co., Chicago; The Crane Co., Columbus; Ohio Lotan Products Co., Columbus; American Brass Co., Waterbury, Conn.; The Linde Air Products Co., Cleveland, Ohio; Air Reduction Sales Co., Cleveland, Ohio; Republic Steel Corp., Massillon, Ohio; The Lincoln Electric Co., Cleveland, Ohio; General Electric Co., Schenectady, N. Y.; Universal Power Corp., Cleveland, Ohio; Hobart Bros. Co., Troy, Ohio; Una Welding Inc., Cleveland, Ohio; Harnischfeger Corp., Milwaukee, Wis.; Electric Welder Corp., Omaha, Nebr.; Central Ohio Welding Co., Columbus; and Swift Equipment Manufacturers, West Alexandria, Ohio.

Joliet Supply House Opens Welding School

Under the capable supervision of H. O. T. Ridlon, the Barrett Hardware Co., Joliet, Ill., is conducting two classes in welding, one of which meets on Saturday afternoons and the other on Tuesday nights. Each course consists of 20 periods of instruction, principally in gas welding, with some are welding instruction included. The students consist largely of blacksmiths and shop owners from Joliet and adjoining communities. Rego and Una equipment is used for instruction.

Huntington Polytechnic Repeats Welding Course

A course in "Designing for Welded Construction," to begin April 3rd, will be offered by The John Huntington Polytechnic Institute, Cleveland, Ohio. A similar course just completed by this school was attended by approximately 25 men. Enrollment for the coming course is limited to 30 men. Applicants should be college graduates in engineering or have equivalent practical experience. The course is planned for designing engineers, machine designers, chief draftsmen, structural engineers, and others interested in adding to their knowledge of design for welding. Instruction will be given in the operation of the arc, so the designer will be thoroughly familiar with the problems of arc welding from a practical or operator's standpoint.

The course consists of a week of intensive work, six days being spent in the welding school of The Lincoln Electric Co., where demonstrations will be given and practice obtained in the operation of the arc. On each evening, from Monday to Friday, a lecture on designing for arc-welded construction will be given at the Institute. Further information regarding this course may be obtained from Alfred Mewett, Dean, John Huntington Polytechnic Institute, or E. W. P. Smith, consulting engineer, Box 683, Cleveland, Ohio.

Shop Owner Says Tidiness Pays

One of the cleanest and best-arranged welding shops in the Middle West is the Iowa Electric Welding Co., 215 First St., N. E., Cedar Rapids, Iowa, of which Henry Malek is the owner. The shop occupies a space 50x60 ft. and employs from two to five welders. Equipment includes 2 portable arc welders, 2 stationary arc welders, 2 gas welding units, and 2 cutting units, all connected up ready for immediate service. In addition, there is the usual line of small tools, grinders, etc. The floor is spotlessly clean from one extreme corner to the other, and every piece of apparatus and each hand tool has a place and is kept in that place except when in use. Every piece of equipment is painted red, which fits into the scheme very well and leaves a favorable impression on the customer or visitor. Mr. Malek believes that painted equipment results in each piece of apparatus being impressed on the customer's mind and gives the feeling that the shop is well equipped to handle any work. The time and labor required to keep a shop tidy is a good investment, says Mr. Malek.

Calls for Welded Job After Seven Years

The prize for the time a job is left in the shop and then called for seems to fall to Frank Zirwes, a job welder in Auburn, Ind. A piece of a cultivator part was brought to him to be welded a little over seven years ago and the owner only recently called for the job. The owner of the part was quite put out when he was informed that the job had been sold for scrap.

Ohio Safety Congress Meeting in April

The 6th All Ohio Safety Congress will be held in the Mill House, Columbus, Ohio, April 25th to 27th. Sixty booths are available free of charge to manufacturers of safety equipment. Further information can be obtained from T. P. Kearns, superintendent of safety and hygiene, Ohio Industrial Commission, Columbus, Ohio.

News in Brief

The Findley Boiler Works, Findley, Ohio, recently installed a Harris Red Head acetylene generator.

The Seibold Welding Shop, Napoleon, Ohio, are building all-welded hot-air furnaces as a side line of production. Arc welding with a Hobart machine is used.

The Buckeye Iron & Brass Works has opened a branch at 2403 S. Ervay St., in Dallas, Texas, in charge of George R. Bardsley. The headquarters of this company is in Dayton, Ohio.

Harry E. Gray has been appointed distributor for the Metallizing Corporation of America, Los Angeles, Calif. Mr. Gray is located in Toledo, Ohio, and covers northwestern Ohio.

Otto H. Stoecker has leased the Schutt blacksmith, wagon and welding shop in Toronto, Iowa, and will continue its operation, specializing on farm equipment and welding jobs of all kinds.

The Williard & Traners welding shop has been formed at 143 E. Perry St., Tiffin, Ohio. A 200-ampere G-E arc welder was recently purchased from the Menna Welding Co., of Toledo.

C. F. ("Tex") Chambers, veteran member of the tool and oil equipment fraternity on the Pacific Coast, has formed the Industrial Art Metallizing Co., with headquarters at 1000 Macey St., Los Angeles.

The Wheatley Bros. Foundry & Machine Co., Tulsa, Okla., has opened a branch machine shop at Longview, Tex., in charge of V. L. Dubois. The shop will specialize in welding and repair of oil-field equipment.

John C. Dewey, of Los Angeles, Calif., who recently opened a new welding shop at 237 South Figueroa Ave. under the name of the Dewey Welding Works, has changed the name to The Arco Welding Works. Mr. Dewey until recently also operated a shop at 2809 Saturn St. in Huntington Park.

The Universal Metallizing Co., Tulsa, Okla., has been incorporated by Hugh Ownby, Ritz Building, of that city, to operate a metal-spraying business.

The Radiator & Welding Works has been established at 312 E. Second St., Sand Springs, Okla. by E. Enochs, owner and manager.

H. J. Bartlett, of the Crane Co., Chicago, will address the Pittsburgh Section, American Welding Society, on April 12th on the subject "Effect of Welding Temperatures on Steel Gate Valves."

W. R. Gay, formerly with the OK Machine Works, Tulsa, Okla., has established the W. R. Gay Welding Co. at 1501 W. Quanah, West Tulsa, Okla. Both acetylene and electric welding are offered.

The Oklahoma Boiler & Welding Works, Oklahoma City, has been incorporated by C. H. Treadway, formerly owner of the Treadway Boiler & Welding Works of that city.

The Tackett Bros. Welding & Machine Co., consisting of Luther T. and Fred R. Tackett, Wilson, Okla., are engaged in welding and machine work in that city, which is in the oil fields of southern Oklahoma.

The Keith Duhman Co. has taken a suite of offices on the twenty-third floor of the Engineering Building, 205 W. Wacker Drive, Chicago. The company's former location was 110 S. Dearborn, Chicago.

The Torpedo Shell Mfg. Co. has been incorporated at Sand Springs, Okla., a suburb of Tulsa, to manufacture containers to hold explosives for shooting oil wells. E. R. Brenneman and E. R. Russell are incorporators.

The Metallizing Company of America, Inc., Los Angeles, Calif., has opened an export office at 15 Moore St., New York, N. Y., in charge of J. Glosner. This office will handle the foreign distributors of "metallizing" equipment.

Homer Baker, Jr., who recently moved to San Diego, Calif. from Russellville, Ark., has opened the Baker Welding Shop at 2432 El Cajon Blvd. in San Diego. This location was formerly known as the Outlaw Welding Works. The new shop will feature general welding and repair work. Mr. Baker recently completed a mechanical and welding course in the Arkansas State School of Technology.

The Welding Engineers, 264 Jefferson Ave., Columbus, Ohio, formerly owned by Ozza L. Rotham, has been purchased by Eugene W. Beeler. Mr. Beeler is the district sales manager for the Harris Calorific line of welding equipment.

Walter W. Trout, formerly district manager for the Lufkin Foundry & Machine Co., Tulsa, Okla., has been transferred to Dallas, Texas. This company employs a great amount of welding in its plants throughout the Middle West.

Frank Mathey, for many years a partner of his brother, C. A. Mathey, in the Mathey Machine Works, Tulsa, Okla., has established the Frank Mathey Machine Works at 315 E. Fourth St., Tulsa, to specialize in general machine work and welding.

The Holder & Champion Welding Co. has been established at 109 S. Cheyenne Ave., Tulsa, Okla., to specialize in automotive welding. A. F. Holder and Ben Champion are the owners. The latter was formerly with L. C. Moore & Co., derrick builders.

H. C. Price, Inc., Bartlesville, Okla., has been awarded a contract for welding the 210-mile 8-in. oil pipeline being built by the Phillips Petroleum Co. from Oklahoma City to Thrall, Kan. The Kelly-Dempsey Co., Hunt Bldg., Tulsa, Okla., are laying the line.

W. J. Williams and H. J. Larison recently acquired the welding shop of J. C. Dewey, 6904 Pacific Blvd., Huntington Park, Calif. In the item regarding this transaction in the February issue of *The Welding Engineer*, Mr. Larison's name was inadvertently omitted.

Sprague & Smith, proprietors of the Waitsburg Welding Works, Waitsburg, Wash., have received a contract for a gasoline dispensing plant for the Walla Walla County Farm Bureau at Walla Walla. They will install a 12,000-gallon tank, pumphouse, platform and office.

Eastern sales and distributing offices were recently opened by the Metallizing Company of America at 214 Provost St., Jersey City, N. J., with R. A. Axline in charge. Mr. Axline, who has been with the company for three years, will handle the sales and service in the eastern states through an organization of distributors in the industrial cities. He will also

"Tobin Bronze *must* be better ...my men swear by it!"

THAT significant statement has been made by many welding foremen about Tobin Bronze...the original low melting point bronze rod. The consistently high quality which has always characterized this rod explains its popularity with thousands of satisfied users who will accept no other brand.

One of a line of seven Anaconda Copper Alloy Rods, Tobin Bronze is the most widely used . . . because of its widespread acceptance as the *ideal rod* for the general oxy-acetylene welding of cast iron and malleable iron. It melts at 1625° F.; preheating is usually unnecessary.

The uniform composition and unvarying quality of *all* Anaconda Welding Rods are due to the long experience and technical knowledge gained in developing a complete line for low temperature welding, both gas and electric. Available through leading distributors...usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. For complete information, ask for Publication B-13

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding	
Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F
for arc welding	
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD., NEW TORONTO, ONTARIO

ANACONDA WELDING RODS

handle technical demonstrations and furnish special technical information to the distributors and users of the process. The eastern offices of the International Metallizing Association have also been opened at the same address, and L. E. Kunkler, president of the company, will spend part of his time at this office.

J. K. Veeder, of C. C. Moore & Co., Southern California representatives for Babcock & Wilcox, addressed the March 9th meeting of the California Natural Gas Association on the subject of "New Developments in Fusion Welding." The meeting was held at the Richfield Cafe in Los Angeles.

The N. E. Canfield Co. has been appointed distributor for the Duro electrode holder in southern California, and the Johnson Welding Equipment Co. is now handling the Duro in Chicago and vicinity, states an announcement received from the Churchward Engineering Co., Inc., New Haven, Conn.

The Hayden Welding Co., Kendallville, Ind., are installing a 2-ton derrick on their portable welding unit. The derrick will be operated by the same power take-off which operates the arc welder. The derrick will be used in the field to lift work so as to get under to weld as well as assisting materially in positioning work.

The Halpin Company, 4116 Clayton Blvd., St. Louis, Mo., have been appointed distributors for the P&H Hansen arc welders in the St. Louis territory. Breen Halpin is president. In taking over this line he is reentering a field that is not new to him, as he has been closely identified to the welding field for some years past.

H. M. Priest, designing engineer, American Bridge Co., will present a lecture on "The Practical Design of Welded Steel Structures" at the meeting of the New York section of the American Welding Society to be held in the Engineering Societies Bldg., on March 23rd. A large part of the information to be presented, in the form of design charts and tabular matter, is being especially prepared for this meeting.

In a telegram received by The Lincoln Electric Co., Cleveland, Ohio, H. H. Tracy, structural engineer for the Southern California Edison Co., says: "Edison Building described in my paper in Second Lincoln Arc Welding Prize Competition withstood recent earthquake entirely without damage." This building, consisting of thirteen office floors and three tenthouse floors, is a class A structure with steel frame and arc-welded seismic bracing designed to resist earthquake shocks comparable to those produced by the San Francisco earthquake of 1906.

Dobson Brothers, of 127 Market St., San Diego, Calif., operating a combined welding and blacksmith shop, recently added electric welding to their line of shop work. They report the purchase of a new 300-amp. Shrader portable gas-engine-driven unit.

The V. B. Anderson Co., dealers in welding supplies in Santa Ana, Calif., recently moved from 111 Spurgeon St. to 120 on the same street. The new location adds convenience and also provides additional space for storing and handling equipment and supplies.

E. O. Massa, operating a welding shop at 171 Paramount Ave., Hynes, Calif., recently acquired the interest of his former partner, T. R. Lewis. Mr. Massa features the welding of castings and aluminum crank cases in addition to general job shop welding and repair work on heavy trucks and trailers. The shop is operated under the name of the Pacific Welding Shop. Until a short time ago, Mr. Massa operated the Standard Welding & Machine Works on N. Cherry Ave. in Long Beach.

Earl C. Smith, chief metallurgical engineer of the Republic Steel Corp., Youngstown, Ohio, addressed a meeting of the American Society for Steel Treating at Muncie, Ind., March 1st, on "Alloy Steels from the Manufacturer's Viewpoint." Mr. Smith's talk was a correlation of the factors affecting the manufacture, treatment, and applications of alloy steels of accepted and widely used analyses. He also spoke on the same subject at meetings of the A.S.S.T. at Buffalo, N. Y., on March 8th, and at Rochester, N. Y., on March 9th.

Fred J. Esslinger has joined the technical staff of The Champion Rivet Company, of Cleveland. He will be engaged in various research capacities, devoting his efforts primarily to the development of welding rod coatings for particular applications. Mr. Esslinger, who is widely recognized as an authority in his field, received his technical training at Friedrich Wilhelm and the Technical Universities of Berlin. He was formerly with The Petroleum Iron Works of Sharon, Pa., in charge of its metallurgical laboratory and welding-rod developments.

The Metallizing Engineering Co., 214 Provost St., Jersey City, N. J., report that they have installed "metallizing" equipment and a complete assortment of machine tools to handle "metallizing" work on a production basis not only in their own plant but in the field as well. This company is starting a two-week school in "metallizing" on April 10th. The first class, it is said, will be limited to 25 and will be in charge of R. A. Axline, of the Metallizing Company of America, assisted by L. E. Kunkler, of the same company, and Alfred J. Weisbecker, of the Simmons Machine Tool Corp.

The Modern Engineering Co. has been appointed by the Hobart Brothers Co. as their representative in the St. Louis district.

The Stonega Coal Co. (Kentucky) have installed a 300-amp. General Electric motor-driven arc welder for their Kentucky mine.

H. L. Spriggs, 1109 W. Pleasant St., Springfield, Ohio, recently introduced a new cast-iron welding flux known as Flash-O-Flux.

Geo. Uhlir, of the Uhlir Welding Co., Beloit, Wis., has been lending the facilities of his laboratory to some of his welder friends and other individuals interested in the microscopical inspection of welds. Mr. Uhlir recently installed a microscope with a magnifying capacity of 250 diameters, as reported in the January, 1933 issue of *The Welding Engineer*.

The Elco Welding Works, under the management of E. L. White, Bell, Calif., was recently moved from 3633 Gage Ave. to new quarters at 3438 Slauson Ave. in Maywood. Mr. White's new shop will be equipped with both acetylene and electric welding equipment, and he will also have portable equipment for handling both field and shop jobs. In addition to general welding, Mr. White specializes on truck repair work and the building of special racing cars. He entered the welding field on his own account only a few months ago, prior to which he was connected with the Welded Products Co. in Bell, Calif.

The Combined Machine Corp., of San Diego, Calif., recently installed a complete and up-to-date welding department in its shop at 14th and "F" Sts. and will feature general repair welding as well as machine work. Both acetylene and electric portable equipment makes possible the handling of any shop or field job. M. L. Beck, formerly associated with L. J. Peters of the Peters Welding Works, which partnership was recently dissolved, is in charge of the welding department. Mr. Beck has had many years

of welding experience, much of which in recent months has been devoted to the specialty of hardfacing. H. O. Stevens is manager of the Combined Machine Corp.

The Bryan Welding & Machine Works, of Bryan, Ohio, recently added a new Airco welding torch and Rego oxygen regulator to their shop equipment.

The Toledo Edison Company Acme Station, Toledo, Ohio, have been using the metal-spray process for a long time, having installed a unit when they were originally leased out instead of being sold. They have been particularly successful in applying the process to step-down transformers located along high-tension lines. The sulphuric acid in the oil smoke in the air caused the oil paint to be short-lived. Now they metal-spray with lead.

"Methods of Organizing and Conducting Industrial Safety Contests" is the subject of a publication issued by the Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y. This booklet outlines the practices of several industrial organizations in stimulating the interest of plant employes in safety activities by competition in the form of accident prevention contests.

· CLASSIFIED ADS ·

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

FOR SALE

For Sale—Bargains—Arc Welders, gasoline or electric drive. 30 days' trial. Terms if desired. Write Ken's Equipment Exchange, Box U 821, Troy, Ohio.

For Sale—2 Lincoln and 1 Wilson Arc Welders, $200, $390, and $325. All 3-phase, 2-arc, 95% new. Send for pictures. Pavlik Bros., 554 Railroad Ave., Kenilworth, Ill.

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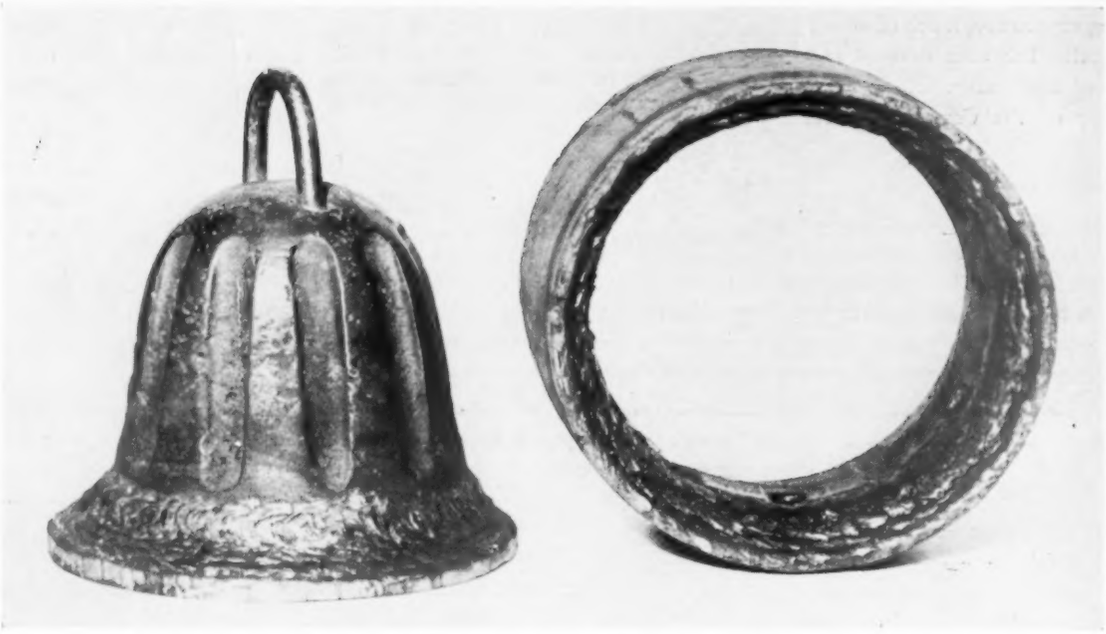

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